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JOURNAL OF PALEONTOLOGY

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ANALYSIS OF TRILOBITE GENERIC NOMENCLATURE AND ITS IMPLICATIONS REGARDING PROGRESS IN PALEONTOLOGY

J. MARVIN WELLER
University of Chicago

ABSTRACT—Data on trilobite generic names and the authors who introduced them show that a period of increasingly fine discrimination began suddenly about 1900 and has continued to the present. Analysis of these data and predictions for the future, based on a continuation of this trend, indicate that the law of diminishing returns is in operation. If paleontology is to continue to make significant progress, the interests of paleontologists must shift from predominantly descriptive morphologic and taxonomic studies to the investigation of the biologic relationships of fossils.

INTRODUCTION

DR. G. G. SIMPSON has recently (1950) analyzed the contents of the 1939 and 1949 volumes of the Journal of Paleontology. He showed that a comparison indicates almost no change during this ten year period in the apparent predominant preoccupation of paleontologists with descriptive morphologic and taxonomic studies. Does this, he asked, reflect a conservative editorial policy on the part of the Journal or does it indicate that paleontologists in general are failing to show increased interest in the biological and evolutionary aspects of their science?

Dr. J. G. Bursch (1951) has similarly analyzed and compared the contents of a prominent Swiss paleontological journal with almost identical results. I agree with him that this parallelism is not coincidence and that it is a reasonably accurate measure of recent and current research. I disagree, however, in his apparent satisfaction with this situation.

Several recent articles (Knight, 1947; Weller, 1947, 1948, 1949; Newell and Colbert, 1948; Jeletzky, 1950; Bell, 1950) have indicated that there is discontent with the present general state of paleontology and its objectives and accomplishments. In spite of differences of viewpoint, various leavening influences may be active but, if so, they do not yet seem to have affected much work that has reached the publication stage, at least in the invertebrate field in America. As one who has contributed to the discussion of these matters, I have been disappointed in the scanty response and the apparent general acceptance of the status quo. My discussion of classification (1949), for example, designed to be provocative because it presented an unpopular point of view, has evoked only two noteworthy replies (Wright, 1950; Sarycheva, 1950), one of which is a Russian diatribe, strong in communistic "dialectics" but weak in scientific reasoning, which seeks to make ideological capital from a non-political matter.

No one is likely to deny that paleontology

has made and is continuing to make progress, but probably few persons have a very clear idea as to the nature and direction of this progress. I am not prepared to review or evaluate all of the activities in this field

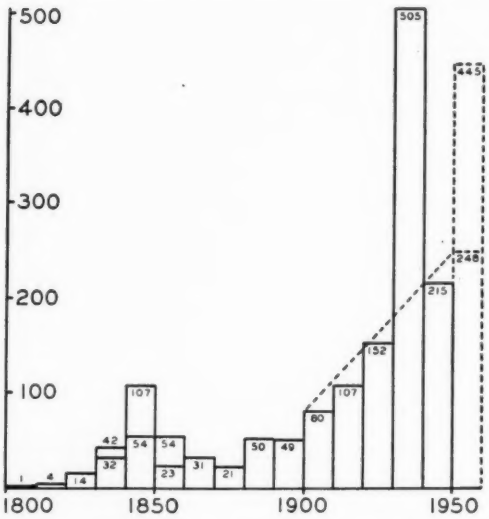

FIG. 1—Number of new genera of trilobites named per decade. Lower figures in columns between 1831 and 1860 exclude the genera of Hawle and Corda, Angelin, and Rafinesque.

but recent work on a catalog of trilobite generic and subgeneric names has provided considerable data relative to taxonomic trends over a period of more than 150 years. Because taxonomy still seems to be the major interest of paleontologists as a whole, a review of these data should be instructive.

I do not know to what extent investigations of other zoologic groups have followed a similar pattern or if similar conclusions can be drawn with respect to them but several friends have suggested that a close parallelism probably exists. Rough checks of the genera of Paleozoic crinoids (Moore and Laudon, 1943), foraminifers (Cushman, 1948), Paleozoic gastropods (Knight, 1941) and nautiloids (Flower and Kummel, 1950) show considerable variation but the total of 2,525 genera considered indicates a generally similar trend (see fig. 4)

18TH CENTURY

The first recognizable published reference to trilobites appeared in England more than 250 years ago (Lhwyd, 1698). Subsequently these peculiar fossils aroused considerable interest and they were reported from various parts of Europe. For more than a century, however, trilobites remained little more than curiosities and all of them were treated as members of a single genus of uncertain affiliations.

19TH CENTURY

The first differentiation of trilobites at the generic level occurred early in the 19th century (Link, 1807). After the publication of Brongniart's famous work in 1822, interest in these fossils rapidly increased and a first peak of activity was attained between 1841 and 1850 (figs. 1 and 2).

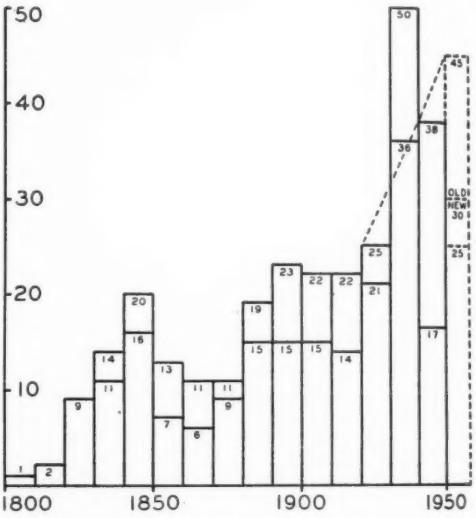

FIG. 2—Number of authors who published new trilobite generic names by decades. Lower figures are the number of authors publishing for the first time.

Figure 1 is based on a preliminary count of the supposedly new genera (and subgenera[1]) named by decades. It does not show the number of taxonomically valid genera nor the number of valid or available names introduced. The names counted include nomina nuda, homonyms and synonyms but each has passed the test that its author

[1] No distinction between genera and subgenera is made here or later in this paper except where particularly mentioned.

intended to name, or thought he was naming, a new genus. *Nomina nova*, even though valid, introduced to replace homonyms have not been counted. These same data are shown as a cumulative curve in figure 5.

Figure 2 shows by decades the number of authors who were active in the discrimination of these supposedly new genera. Joint authors were counted as one unless each also published independently during the same decade. If an author published during more than one decade he was counted in each. Figure 6 is a cumulative curve of authors. It is based on somewhat different data (lower parts of columns in fig. 2) because there is no duplication—although an author may have published during more than one decade, he was counted only once.

Figure 3 shows the average number of

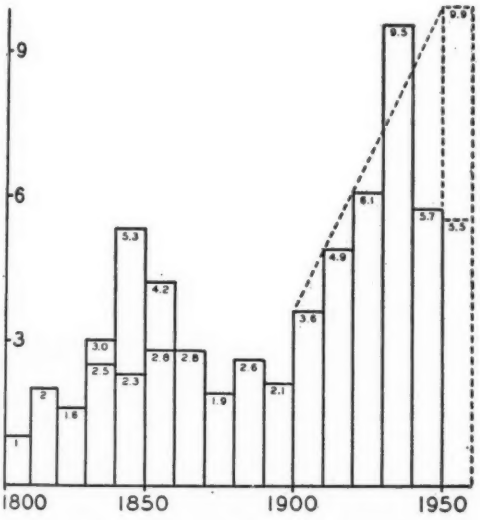

FIG. 3—Number of new trilobite generic names per author by decades showing average relative productivity. Lower parts of columns between 1831 and 1860 exclude genera of Hawle and Corda, Angelin, and Rafinesque.

new genera proposed per author per decade. This indicates approximately the relations which exist between the data of figures 1 and 2, but not exactly, because if joint authors also published separately, their joint genera were counted for both of them.

Data for the last few years of the 1941 to 1950 decade are undoubtedly somewhat incomplete and the counts have been altered slightly to conform to estimates but they are certainly under- rather than over-estimated.

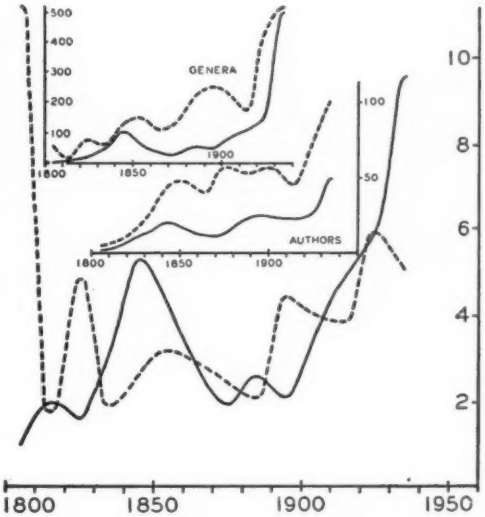

FIG. 4—Solid line shows number of new trilobite genera per author per decade—see figure 3. Dashed line shows, for comparison, number of new genera of Foraminifera, nautiloids, and Paleozoic crinoids and gastropods per author per decade. Inserts are similar curves for genera and authors—see figures 1 and 2.

Figure 4 shows by curve the number of genera of trilobites per author per decade—the same data as in figure 3—and a similar curve for the other groups of animals mentioned in the introduction. The sharp irregularities in the first halves of these curves reflect mostly the work of a few exceptionally prolific authors such as Montfort (1808–10), 40 genera; d'Orbigny (1820), 45 genera; and Hawle and Corda (1847) 53 genera. In the early decades, authors were few and these irregularities are more conspicuous than significant. Later the work of similar authors is averaged down because more persons published. The interesting points brought out by this figure are that both curves are low in the latter part of the 19th century and both rise sharply thereafter. The comparative—dashed—curve rises earlier than the trilobite curve because of Hyatt's publications. It also shows a drop in the 1931 to 1940 decade that may not

be real. The data upon which the comparative curve is based certainly are not nearly so complete as the data of the trilobite curve and probably they are most incomplete in recent years. Most of the remarks presented later concerning the trilobites are also applicable to the combined comparative groups if leeway of ten years, one way or the other, is allowed.

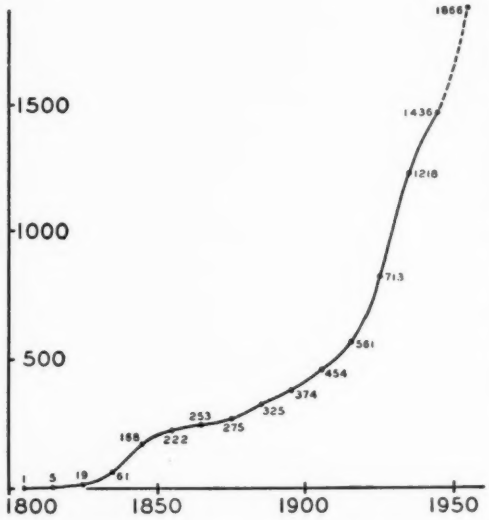

FIG. 5—Cumulative curve of new trilobite generic names.

Figures 1, 2 and 3 all show the first maximum between 1841 and 1850. Almost half of the new genera of this decade were introduced in a single work by Hawle and Corda (1847). Likewise, between 1851 and 1860, more than half of all genera were proposed by Angelin (1851, 1854) and between 1831 and 1840 an unduly large number of genera was named in a single valueless paper by Rafinesque (1832). These publications are quite unrepresentative of their times and they account for the prominence of the columns between 1831 and 1860 in figures 1 and 3. None is now of much scientific interest but two of them are very important nomenclaturally. The lower parts of these columns in figures 1 and 3 represent the genera per author exclusive of these works.

This first period of activity, whose high point of accomplishment was marked by Barrande's monumental volume of 1852, witnessed great progress in the knowledge and understanding of trilobites. It can be justly termed the golden age of trilobite investigations. No subsequent equal period has produced a comparable amount of further fundamental progress.

The first maximum of activity was followed by a period of about 50 years of lesser interest in the creation of new trilobite genera which reached its nadir between 1871 and 1880, when fewer persons were active and less was published than at any time in more than 40 preceding years. Perhaps this lag was a natural one and necessary to allow investigations to catch up with the prolific genera of Hawle and Corda and of Angelin and the encyclopedic work of Barrande. Perhaps also it reflects the period of political disturbances and economic difficulties in Europe that culminated in the depression following the Franco-Prussian war.

After 1880, the number of active authors abruptly doubled, to approximately the number who published during the first peak between 1831 and 1840, and then remained nearly constant for 50 years (see fig. 2). During the first 20 years of this period, or until 1900, the productivity per author remained close to what it had been for the

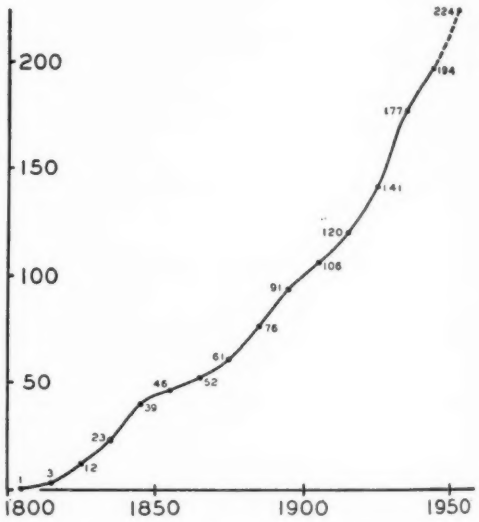

FIG. 6—Cumulative curve of authors who published new trilobite generic names.

previous 80 years, if the works of Hawle and Corda, Angelin and Rafinesque are disregarded (see fig. 3).

20TH CENTURY

The beginning of the 20th century brought a distinct and very significant change. Figure 1 shows that the number of new genera increased each decade to 1940. Figure 2, however, shows no important change in the number of active authors before 1931. The increase in the number of new genera during this period resulted, therefore, from the greater productivity per author as shown in figure 3. Between 1801 and 1900 the average number of genera produced per active author per decade (excluding Hawle and Corda, Angelin and Rafinesque) was 2.3 but from 1901 to 1940 this increased at an average rate of nearly 50 per cent per decade.

The second maximum between 1931 and 1940 is an extraordinary one, out of all proportion to any reasonable expectation based on the accomplishments of previous years. It seems to have resulted from a peculiar combination of circumstances that brought an unusual number of studies to publication and any attempt to explain or evaluate it requires cautious and special interpretation. Probably the death of Walcott, who had largely preempted the field of Cambrian paleontology in America, was an important factor.

The drop subsequent to 1940 evidently reflects, in part, the influence of the war and illustrates vividly its effect on scientific research that could have no relation to military activity. Surprisingly, World War I had no comparable effect.

STANDARDS OF DISCRIMINATION

If uniform standards were followed in the discrimination of genera, the discovery of new forms would decline progressively. The exact rate of decline is not determinable because genera are subjective groups and the total number that exists at any level of differentiation is not known. Also, the declining rate of discovery would be a function of the amount of study devoted to genera and for the trilobites this has varied considerably. A crude approximation, however, is possible.

The relative amout of study in equal intervals of time is indicated roughly by the number of publishing authors. On this basis

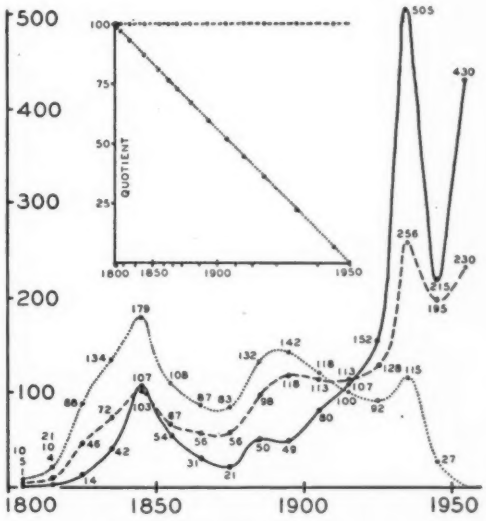

FIG. 7—Theoretical discovery curves based on number of publishing authors, calculated by decades, compared to actual curve. Solid line, actual curve—see figure 1. Dotted line, assuming all genera were discovered by 1950. Dashed line, assuming an infinite number of genera. Insert shows method of calculating theoretical discovery quotients—time plotted on abscissa proportional to number of publishing authors.

a theoretical discovery quotient can be calculated for each decade (fig. 7 insert). If the number of genera is finite, these quotients will decline progressively. If it is infinite the quotient is a constant.

Figure 7 shows by curve the same data indicated by columns in figure 1—the number of new genera proposed per decade. The other curves have been calculated by multiplying the number of publishing authors by the theoretical discovery quotient for each decade on the assumptions, respectively, a) that all genera had been discovered and named by the end of 1950, and b) that an infinite number of genera exists. These curves show the number of genera that would have been discovered and named per decade had uniform standards of discrimination been employed. All three curves are directly comparable because they are scaled

to total an equal number of genera at the mid-point of the 1940's.

The change in standards that occurred at the turn of the century is shown in figure 7 by the rise of the actual curve at the same

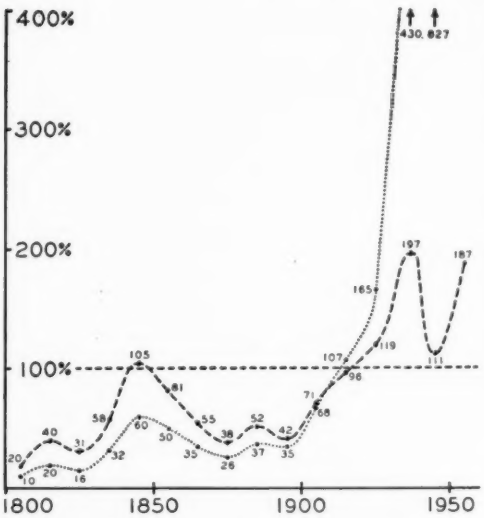

FIG. 8—Ratios of actual curve to theoretical curves of figure 7. Dotted line, assuming all genera were discovered by 1950. Dashed line, assuming an infinite number of genera.

point (1900) where both theroretical curves decline.

The curves of figure 8 show the ratios between the actual curve of figure 7 and the two theoretical curves. The change also is apparent here in the rise in both curves at a point identical to that of figure 7. This is much more striking in the curve constructed on the assumption that all genera were discovered by 1950. Presumably this is much closer to any rational curve reflecting the actual situation than is the other based on the assumption that an infinite number of genera exists. It shows that relative discrimination was fairly constant for 100 years, averaging about one-third of the theoretical rate. Then it rose rapidly and during the last 50 years has averaged about three and one-half times the theoretical rate, a tenfold increase.

The change in standards and increased productivity is still more clearly indicated in figure 9 which shows the ratio of genera per author per decade to the average number of genera per author per decade during the 19th century.

No explanation seems adequate to account for this striking change except that a new philosophy of generic discrimination achieved rapid and increasingly wide acceptance. In consequence, the 20th century trilobite genus is not the same as the 19th century genus. An era of relative conservatism ended and a new era of much finer discrimination began.

An attempt to establish the origins of the new philosophy can lead to no certain conclusions. They are obscure and have their roots far back in the work of the 19th century. Greater discrimination in the recognition of genera was a natural and almost necessary development consequent upon the discovery of new forms and more and better preserved specimens. One might expect discrimination to have increased in a gradual and regular manner but quite evidently this did not occur.

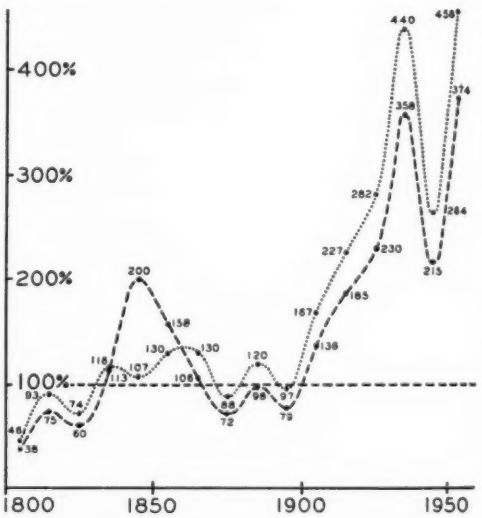

FIG. 9—Ratios of genera per author per decade—see figure 3—to average number of genera per author per decade between 1801 and 1900 Dashed line, all genera and authors. Dotted line, excluding genera of Hawle and Corda Angelin and Rafinesque.

SPLITTING

The number of genera was augmented by both the discovery of new and the splitting of old ones. No sharp demarcation can be

drawn between these processes because a person inclined toward splitting would also recognize new genera on the basis of less distinctive new species and *vice versa*.

Figure 10 shows the percentages of new genera based on new species for both 10 and 20 year periods. These percentages are, of course, inversely relational to the splitting of old genera in the strictest sense. The 10 year columns demonstrate a general but irregular increase in generic splitting but this trend is much more clearly shown by the 20 year columns. Between 1881 and 1920 more than half of all new genera resulted from the restriction of old ones.

Similar data are not available for discrimination at the species level, but figure 10 suggests a rough alternation in the relative emphasis that has been accorded the recognition of new genera and new species. Splitting of genera increased rapidly during the first three decades of the 19th century, probably strongly influenced by Brongniart's studies. Although he did not publish until 1822 some of his conclusions were announced at a meeting of the French Academy in 1815 and several short notes on his work were published by his associate, Desmarest, between 1816 and 1819.

Following this period an increasing number of new species was described and new genera were based on many of them. The high-point of 80 per cent between 1851 and 1860 corresponds with the publication of Angelin's work. From 1861 to 1890 splitting again increased progressively and emphasis seems to have shifted back to generic discrimination.

Before 1931 the designation of a type species was not mandatory and genera with types not established in the original publications have been ignored in making the calculations shown in figure 10. In these cases the authors' intentions are not known. Consequently the percentages shown are based on variable fractions of all the new genera proposed and too much significance should not be attached to them.

Figure 10 suggests that generic splitting decreased in the early decades of the present century and that remarkably stable relationships have prevailed since 1931. These conclusions are not necessarily justified, however, and the apparent reversal from the 19th century trend may reflect only a change in the practice of generic type selection. Formerly an old and supposedly well known species was generally chosen as the type of a new genus created by the subdivision of an old one. In more recent years, it has become more common to name a new species as the type of a new genus produced

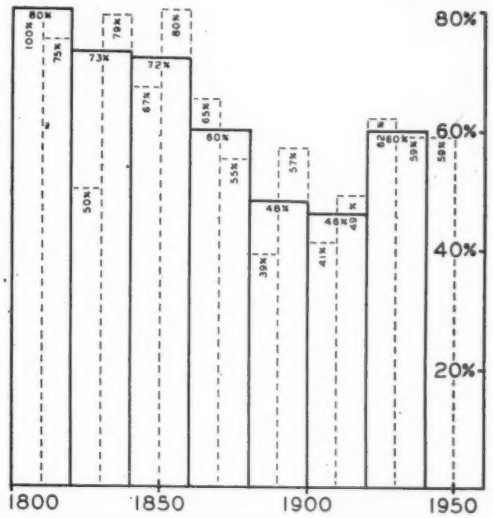

FIG. *10*—Diagram showing percentages of new genera based on new species described in the same publications by 10 and 20 year periods.

in exactly this same way in order to eliminate the possibility of confusion resulting from the misidentification of specimens or the misinterpretation of old species.

MODERN TRENDS

With the beginning of the present century, two quite different trends in trilobite studies have become increasingly apparent. One has been somewhat more characteristic of European paleontologists than of their colleagues in other lands. It has resulted in the publication of a series of papers or short monographs devoted to the analysis of entire individual families or larger groups. Most of these publications are not concerned with species except as they are considered to be representatives of genera. Several of these papers appear to have been based, to a considerable extent, on published descriptions and illustrations rather than on the observation of actual specimens. The

skill and judgement evident in such studies has varied greatly and the conclusions reached are not all equally acceptable. All of these works, however, appear to be more or less rational attempts to organize scattered and unwieldy information and they are of much broad general interest for that reason. Most of them resulted in the proposal of new genera (or subgenera) for the reception of species not considered compatible with the groups already recognized.

The other trend has been a continuation of faunistic, rather than taxonomic, studies. Much of it has been characterized by the description of a multitude of new forms with very minor regard to their systematic relationships. This has been particularly true of American work on Cambrian trilobites which has been singularly lacking in much more than a strictly descriptive approach. Papers describing from half a dozen to a score or more new genera in no particular order are not uncommon. Some of this work seems so strongly tinged with a defeatist attitude respecting the possibility of determining systematic relationships that one suspects the authors' interests did not extend much beyond the rather mechanical naming of new forms. In 1942 (p. 2), Resser wrote "Trilobites cannot yet be satisfactorily classified, and to attempt to do so merely adds to the confusion now existing."

This attitude seems to have gained respectability through Walcott's later work. It is apparent to a greater or lesser degree in the publications of most trilobite students who, subsequently, have had close contacts with the United States National Museum, including some foreigners who carried it back to their native lands. This attitude has had the unfortunate result, in this country at least, of discrediting all previously suggested trilobite classifications and today there is no generally accepted systematic framework for the reception of this very important group of fossils.

GENERA AND SUBGENERA

Another striking difference between many recent North American and European publications also reflects the different regard in which systematics is held on the two sides of the Atlantic. Many European authors have employed the subgeneric category for groups distinguished by minor differences, whereas, no subgenera of trilobites have been recognized in North America for many years. This practice of American authors, considered by some to be conservative, certainly indicates their reluctance to commit themselves with respect to matters of classification or relationship and suggests a general lack of interest in such matters.

In this analysis of trilobite nomenclature, no distinction has been made between names proposed for genera and subgenera because sooner or later almost every group introduced as a subgenus is raised to full generic rank. In this respect there has been very little difference between European and American practice.

THE FUTURE

Any attempt to predict the future on the basis of the past is dangerous because another change as striking as that which marked the opening of the 20th century might occur at any time. It may be interesting, however, to determine, if possible, where present trends will lead if they are continued. Unfortunately, these trends are not entirely clear as shown by the irregularities of the last two decades apparent in figures 1, 2 and 3 which might be interpreted in different ways. Both figures 1 and 2 seem to show abnormal increases between 1931 and 1940. Only in figure 3, representing author productivity, does the column for this decade seem not to be greatly out of line with the trends of previous years. The declines of the last decade almost certainly reflect the influence of the war which interrupted paleontological work and perhaps prevented the emergence of new authors. Even so, both the number of authors active and the number of genera proposed during the last decade exceed those of the years from 1921 to 1930. On the whole, there seems to be no reason to conclude that, if reasonably normal conditions prevail, the present decade will not see important increases in both the number of authors and their productivity and also, consequently, in the number of new genera proposed.

In an attempt to estimate these probable increases, dashed trend lines have been drawn in figures 1, 2 and 3, and the corre-

sponding projected columns constructed for the 1951 to 1960 decade. From each pair of these projected values, the third value was computed and these also are shown in the figures. The fact that these computed values for the number of authors and their productivity, as shown in figures 2 and 3, are less than the corresponding figures for the past decade, suggests that the projected number of new genera for the present decade is too low and that the calculated value of 445 based on the projected number of authors and their productivity is more acceptable. This implies that the war did not so much reduce the number of publishing trilobite students as it interrupted their work and reduced their productivity. Such a conclusion seems reasonable.

An estimate of the number of new genera likely to be proposed during the current decade can also be made on the basis of the past performance of individual authors. Data on trilobite publications from 1807 through 1950 break down as follows:

About 200 authors have proposed new genera.

About 80 of them proposed only one genus each.

One author proposed 124 new genera.

The least productive 100 authors proposed only 8.1% of all genera.

The 13 most productive authors (6.5% of total) proposed more than one-half of all genera.

These 13 include Hawle and Corda (1847), 53 genera, and Angelin (1851, 1854), 27 genera. No publication introducing a comparable number again appeared until 1924, when Walcott set an all-time record by describing 30 new genera in only 8 pages of text!

The average date of first publication of a new genus by the remaining 11 authors was 1922.

Of these 11 authors, 6 are Americans and also 6 are still living and active.

The average date of first publication of a new genus by the 6 living and active authors was 1933.

The rate at which these 6 authors have proposed new genera is 25 per year.

Such a rate represents more than 60% of all new genera described since 1933.

On this basis, the prediction may be made that during the present decade the last mentioned 6 authors, or others who will replace them, probably will describe 250 new genera. If this number is 60% of the total, the latter will be 415 new genera. This figure compares closely with the 445

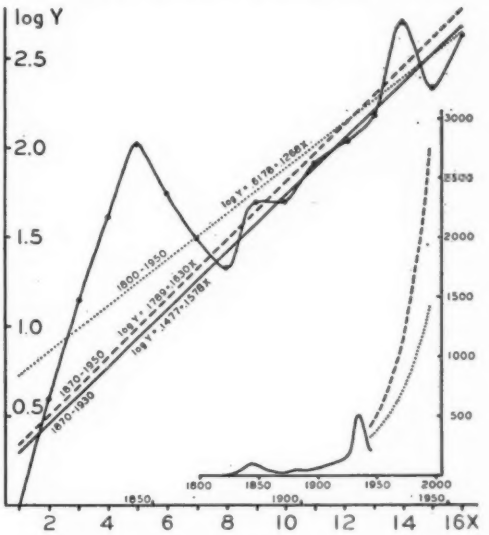

FIG. *11*—Logarithmic curve of number of trilobite genera named by decades and calculated curves of closest fit. In insert, corresponding maximum and minimum calculated curves projected to year 2000 drawn with arithmetic coordinates.

genera of the first estimate and an intermediate figure of 430 new genera may be accepted as a reasonable prediction.

Further peering into the future soon becomes absurd but nevertheless a projection of present trends may be instructive. This is shown in figure 11 where the number of genera per decade curve is plotted on a logarithmic scale. Also shown are three calculated logarithmic curves which fit most closely the entire generic curve and its more recent parts. These show (see insert) that if present trends continue, the introduction of between 1,500 and 2,700 new genera can be anticipated in the 1991 to 2000 decade! This is so utterly fantastic that it can be dismissed without comment.

Even without logarithmic increase, the present rate of generic introduction, if continued, would double the present number of genera before 1985.

CONCLUSIONS

Most paleontologic studies are predominantly morphological and differ from those of a century ago mainly in their greater regard for detail. Additional morphological knowledge must be obtained if progress is to continue but in so far as this knowledge is utilized largely in the creation of more and smaller taxonomic groups, the law of diminishing returns is certainly in operation and these groups are rapidly becoming less significant. This kind of work can, I think, justly be regarded as old style paleontology. Although new groups undoubtedly remain to be discovered and described, the continued preoccupation of most paleontologists with studies of this kind is not, in my opinion, likely to result in a comparable amount of future progress.

If such a view is justified, this analysis of trends in trilobite studies admits of only one conclusion which probably is applicable equally to most other groups of fossils. This seemingly inescapable conclusion is that paleontologic interests and emphasis should be changed and that old style paleontology should give way to new. If it does not, present trends will end in futility and important new morphological observations are likely to be lost almost inextricably in an ever increasing maze of less and less significant detail.

The refinement and extension of taxonomic schemes, which all too often involve the recognition of more and more less and less well founded genera and species, should not be accepted as the ultimate objective of paleontology. In the first place, present biologic understanding of fossils as once living animals is inadequate as a foundation for many of the taxonomic schemes that have been proposed. Also, other biologic relationships of fossils besides the grosser patterns of phylogeny, which these schemes supposedly portray, should be of interest to paleontologists and when better understood are certain to be of much greater service to both paleontology and geology. Consequently, I believe that emphasis in paleontology should be shifted as rapidly as possible to three closely interrelated types of biological studies and that taxonomy should be accepted as a less theoretical and more practical matter that will at least not complicate these studies.

The three types of biological studies which, in my opinion, offer the greatest promise of paleontologic achievement are:

1) The investigation of fossil populations with regard to their geographic and stratigraphic distribution and variation. In a broad sense, this includes or at least overlaps the other two.

2) The investigation of the environmental relations of fossil populations with regard to their biological and physical associations as revealed by faunal and sedimentary analyses.

3) The investigation of evolutionary trends in closely related sequent populations from precisely determined stratigraphic zones.

Studies of these types are not so easy to undertake as conventional faunal studies. More numerous and more carefully made collections are required and more mature judgement is demanded of the investigator. Perhaps the greatest difficulty is that few paleontologists are adequately prepared to work along these lines and a new generation of students may have to be trained before such fundamental problems can be investigated effectively.

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MISSISSIPPIAN CEPHALOPODS FROM WESTERN UTAH

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ABSTRACT—Some 400 cephalopods were recently collected from a shale zone in the Mississippian strata of the Confusion Range in central western Utah. This fauna includes representatives of the genera *Mooreoceras*, *Bactrites*, *Goniatites*, *Lyrogoniatites*, *Neoglyphioceras*, *Girtyoceras?*, *Dimorphoceras*, and *Epicanites*. Two new species, referable to *Lyrogoniatites* and *Epicanites*, are described and illustrated, along with representative specimens of the other genera. A brief discussion of the associated pelecypods is included. The containing beds are considered to be Meramec in age and to be the approximate equivalent of the cephalopod-bearing portions of the Heath formation of Montana, the White Pine shale of Nevada and California, the Helms and Barnett formations of Texas, the Caney shale of Oklahoma, and the upper Viséan of Europe.

INTRODUCTION

THE presence of an extensive section of Mississippian limestones and shales in the Confusion Range of western Utah was first given detailed consideration by Bacon in 1948. Prior to his paper and the abstract that preceded it (Bacon, 1941) the geology of the Confusion Range was little known, for only three very brief references to the area had appeared in the literature (Gilbert, 1875, 1890, 1928). Fairly recently Newell (1948, pp. 1053–1058) has discussed the Permian section there and Ogden (1951, pp. 62–82) the Carboniferous.

Bacon's study called attention to the occurrence in the Mississippian beds of a well-preserved and extensive cephalopod assemblage which in general composition is similar to those recently described from the White Pine shale of adjacent ranges to the west in Nevada. Through correspondence, Dr. Bacon kindly encouraged the undertaking of a detailed study of the cephalopod fauna in the Confusion Range and provided additional information about the collecting localities. In June of 1949, the junior authors visited the range and secured the materials on which this paper is based. A small pelecypod assemblage was also obtained and was submitted to Dr. Norman D. Newell who supplied a brief report which we are including.

LOCATION AND GENERAL FEATURES OF COLLECTING AREA

The Confusion Range is located in central western Utah, and it extends for some fifty miles in a north-south direction, chiefly in Millard County but continuing to the north into Juab County. It is situated well within the Basin and Range Province and is bounded on the west by Snake Valley and the Snake Range of Nevada, and on the east by White Valley and the adjacent House Range. Elevations in the Confusion Range exceed 8,000 feet, with the adjacent valley elevations being for the most part between 4,500 and 5,000 feet. Although this range has a relief of some 3,500 feet, it is dwarfed by the higher and more rugged House Range to the east and especially by the Snake Range to the west, which has elevations in excess of 13,000 feet (for example, Wheeler Peak). Vegetation is sparse on the Confusion Range, which consists largely of a series of elongate barren ridges. The topography of the area is portrayed in a rather general way on the Fish Springs quadrangle (scale 1:250,000; contour interval 100 feet). U. S. Highway 6 offers the best access to the range.

Bacon (1948, p. 1031) has indicated that the "stratigraphic section of the Confusion Range includes an estimated 16,000 to 24,000 feet of sedimentary rocks ranging

from Ordovician to Lower Triassic." Beds of Mississippian to Permian age comprise a large part of the column in this area. The structure of the range is complex, and many of the numerous synclines and anticlines are complicated by normal faulting and probably some overthrusting.

PRESENT STUDY

The area investigated during the field work for this report is situated along the east side of the Confusion Range about four to five miles east-southeast of Cowboy Pass. All of the fossils were obtained from an elongate outcrop which exposes some 50 to 75 feet of beds and which we are regarding as a single locality. It extends along the strike for about a mile at approximately latitude 39° 18′ 16″ N. and longitude 113° 38′ 15″ W. and includes "locality 31" of Bacon (1948, fig. 3 [map], p. 1038). The beds here dip to the west, and the stratigraphic section was measured from west to east as follows:

	Thickness (Feet)
Dark-brown limestone, weathers smooth, fossiliferous	25 (Top)
Light-brown shale	71½
Thick-bedded limestone	26
Light-brown shale	63
Arenaceous limestone, weathers light-brown	37½
Shale, partially covered by alluvium	227
Very thin-bedded dark-gray limestone, slightly offset by small transverse faults, fossiliferous (chiefly pelecypods)	5
Shale and alluvium	117
Road	10
Alluvium, contains a small wash	60
Thick-bedded limestone, weathers light-brown	17
Black fissile shale	9
Thin-bedded limestone stringer	2
Light-brown shale with a few thin limestone stringers **(cephalopods and pelecypods of present report secured from this unit)**	77
Limestone, composed of 10″-beds, weathers dark-gray	3
Light-brown shale, fossiliferous	170
Massive-bedded limestone, weathers dark-gray, slightly offset by transverse faults	7
Shale, partially covered by alluvium, with a few limestone lenses	147
Shale, covered by limestone talus	136
Massive-bedded limestone, medium-gray (Madison?; probably Midridge of Bacon and Ogden)	80 (Base)

Although a few of the fossils secured are testaceous, most of them are internal molds composed of calcareous ferruginous shale. Some, which are largely calcareous, occur in limestone nodules (ranging up to several inches in diameter) and in small limestone lenses that occur in seams or are irregularly scattered throughout the calcareous shale that constitutes the bulk of the containing beds. For the most part, the fossils are exceptionally well preserved and lend themselves readily to microscopic inspection and to ontogenetic studies which involve the breaking back of mature conchs so that the nature of the sutures, ornamentation, and other characteristics of the inner whorls can be determined. Several such studies have been made, and they are incorporated into the portion of this report that deals with systematic paleontology. Microscopic fossils in the cephalopod-bearing shale are largely brachiopod spines, minute crinoid stems, foraminifers, and a few ostracodes. The associated macro-fossils are chiefly pelecypods, but corals, crinoid fragments, brachiopods, and gastropods are also present in the assemblage.

COMPOSITION AND SIGNIFICANCE OF THE FOSSIL COLLECTION

A special effort was made to secure as many cephalopods as possible from the outcrop, and the results obtained are shown at the top of the next page.

The associated pelecypods were tentatively identified by Dr. Norman D. Newell as follows: *Allorisma* cf. *A. hannibalensis* (Shumard), *Nuculana similis* Herrick, *Caneyella nasuta* Girty, *Nuculopsis* cf. *N. girtyi* Schenck, *N.* cf. *N. corbuliformis* (Hall), and *Palaeoneilo* sp.

	Fragments	*Good specimens*
Mooreoceras crebriliratum (Girty)	120	22
Bactrites cf. *B. carbonarius* Smith	32	4
Goniatites choctawensis Shumard	0	2
Lyrogoniatites utahensis, n. sp.	168	39
Neoglyphioceras subcirculare (Miller)	4	13
Girtyoceras? sp.	0	2
Dimorphoceras humphreyi Youngquist	0	1
Epicanites baconi, n. sp.	0	1

As in all of the late Mississippian cephalopod faunas known from America, ammonoids are more abundant than nautiloids in our collection from the Confusion Range. *Lyrogoniatites* is clearly the most common generic element; *Neoglyphioceras* is moderately well represented; and *Dimorphoceras*, *Epicanites*, *Girtyoceras?*, and *Goniatites* s. s. are rare. *Bactrites* and *Mooreoceras* are relatively abundant in comparison to their occurrence elsewhere in similar faunas, but most of the specimens obtained are small fragments, so the number of individuals represented may not be as great as the figures seem to suggest. Nevertheless, for an American cephalopod fauna of this general age, nautiloids are numerous but not varied.

Several North American formations appear to be of about the same age as the Mississippian cephalopod-bearing beds of the Confusion Range. Among these is the White Pine shale of Nevada (and California). That formation is of widespread occurrence throughout eastern and east-central Nevada, and it has yielded more than 3,000 cephalopods (chiefly ammonoids), which are available to us for direct comparisons. In generic composition, the White Pine fauna is, in most respects, similar to the Utah one under consideration. That is, both are known to contain representatives of *Mooreoceras*, *Bactrites*, *Goniatites*, *Dimorphoceras*, *Epicanites*, and probably *Girtyoceras*. However, *Lyrogoniatites* is abundant in the collection we are studying but is of very doubtful occurrence in Nevada. Insofar as numbers of individuals are concerned, there are striking differences between the two assemblages. *Cravenoceras*, which constitutes more than 90 per cent of the known cephalopod fauna of the White Pine shale, is not present in our collection from Utah. *Goniatites* is moderately abundant in the White Pine but is rare in the Confusion Range material. *Lyrogoniatites*, which predominates in the assemblage under consideration, may not even be represented in those known from Nevada. No particular significance should probably be attributed to the apparent absence of *Eumorphoceras* in the collection being studied, for only four specimens of it were found among the several thousand goniatites we have examined from Nevada (and California). In this region, *Dimorphoceras* is known from only a single individual from Utah and one from Nevada.

The generic composition of the cephalopod faunas just discussed is in general similar to that of the Barnett formation of central Texas. However, in the number of individuals referable to each of the several genera involved, the Barnett assemblage differs somewhat from those found in Nevada and Utah and is more or less intermediate between them, for it contains a good many representatives of *Cravenoceras*, *Goniatites*, and *Lyrogoniatites*. Specific analyses of the respective ammonoid faunas do not appear to be any more revealing than are comparisons of the genera. The Confusion Range has yielded a considerably larger number of individuals that belong in *Mooreoceras* and *Bactrites* than have the White Pine and the Barnett shales, but these forms seem to have very little stratigraphic significance. Although the containing beds in the three areas are almost certainly not of exactly the same age, the slight differences in their faunas are probably due chiefly to variations in lithologic facies with related bio-facies changes. That is, the cephalopod-bearing strata of the Confusion Range are predominantly calcareous, slightly ferruginous, brown shales. The White Pine shale is for the most part black and highly carbonaceous, and the fossils occur chiefly in dense black limestone lenses and are

themselves composed of very dark limestone. Some of them contain liquid petrolic residues (Youngquist, 1949, p. 277). The Barnett is in part dark and petroliferous but contains some lighter-colored shaly zones. Thus in its lithology, as well as in the composition of its cephalopod fauna, the Barnett is in some respects intermediate between the White Pine of Nevada and the Mississippian strata of the Confusion Range.

The more significant elements in the Utah cephalopod fauna we are studying appear to be the genera *Goniatites*, *Lyrogoniatites*, *Neoglyphioceras*, *Girtyoceras?*, *Dimorphoceras*, and *Epicanites*. Certain of these are known from the Heath formation of Montana; the White Pine shale of Nevada and California; the Helms and Barnett formations of Texas; the Caney shale of Oklahoma; the Moorefield, Ruddell, Batesville, and Fayetteville formations of Arkansas; the "Meramec" beds of Kentucky; and the Floyd shale of Georgia. We believe that all of these cephalopod-bearing beds are of about the same general age. The apparent absence of *Eumorphoceras* and *Cravenoceras* from the Confusion Range fauna may be real and therefore significant, or it may be merely a matter of collecting and of no importance. We interpret the faunal evidence at hand as indicative of a Meramec age for the containing beds.

Several of the genera in the Utah collection have been given special consideration by European geologists in the zoning of the Carboniferous rocks in their portion of the world. Both *Goniatites* and *Girtyoceras* occur there in the middle and upper Viséan. *Dimorphoceras* ranges from the middle and upper Viséan into both the lower and the upper Namurian. *Epicanites* appears to be limited to the upper Viséan and the lower Namurian. *Dimorphoceras humphreyi* Youngquist of the Confusion Range is specifically close to *D. pseudodiscrepans* Moore, which in England ranges stratigraphically throughout Bisat's P_1 zone —that zone includes somewhat more than the lower half of the upper Viséan. In Europe, *Cravenoceras* and *Eumorphoceras* (not present in the collection at hand) are said to appear first in the basal portion of the Namurian. All in all, it seems to us that the cephalopod assemblage from western Utah is perhaps closest to that of the upper Viséan of the European section.

The small but reasonably well preserved assemblage of pelecypods that was found in association with the Confusion Range cephalopods has been studied cursorily by Norman D. Newell. In addition to the tentative identifications listed above, Dr. Newell has written us the following significant comments about these pelecypods:

> The general assemblage has very little meaning from the standpoint of precise stratigraphic horizon, but the one species identified as *Caneyella nasuta* seems to strongly point toward the correlation with the Caney shale of Oklahoma. That species is unknown from other horizons, so far as I am aware. . . . We still have the general problem, interpretation of the time value of this stratigraphic facies, and as a rule wherever the so-called Caney fauna is found it occurs in relatively dark colored argillaceous rocks, and it is quite possible that the general assemblage, at least, is an indicator of environment rather than time. Nevertheless, the general assemblage of the pelecypods, together with the goniatite evidence, leads me to feel quite confident that we are dealing with one of the stages near the middle of Mississippian time.

SUMMARY AND CONCLUSIONS

The late Paleozoic is well represented by limestones and shales in the Confusion Range of western Utah. During the summer of 1949 some 400 cephalopods were collected from a shaly zone in the Mississippian rocks of the east-central portion of the range. Many of these specimens are fragments. However, some of them are exceedingly well preserved and retain the juvenile whorls in an excellent state of preservation. Certain of the better individuals are illustrated, and others have been prepared to show the nature of the sutures during ontogenetic development. The great majority of the ammonoids are referable to *Lyrogoniatites*, but *Goniatites* s. s., *Neoglyphioceras*, *Girtyoceras?*, *Dimorphoceras*, and *Epicanites* are also represented. Nautiloids are relatively abundant in comparison to other American cephalopod faunas of similar age, but the variety is indeed limited. Associated with these cephalopods are various types of fossils, especially pelecypods tentatively referred by Norman D. Newell to the genera *Allorisma*, *Nuculana*, *Caneyella*, *Nuculopsis*, and *Palaeoneilo*.

On the basis of the cephalopods (and to a

minor extent associated fossils), it is concluded that the containing beds are about the same general age as the Heath formation of Montana; the White Pine shale of Nevada and California; the Helms and Barnett formations of Texas; the Caney shale of Oklahoma; the Moorefield, Ruddell, Batesville, and Fayetteville formations of Arkansas; the "Meramec" cephalopod-bearing beds of Kentucky; and the Floyd shale of Georgia. Certain differences exist between the composition of the Mississippian cephalopod fauna of the Confusion Range and those known from the various stratigraphic units just listed. However, the dissimilarities are probably to be explained largely by lithologic and bio-facies variations, and only secondarily by slight differences in age. With regard to the European section, our fauna seems to be most nearly like that found in the upper Viséan.

ACKNOWLEDGEMENTS

Professor Charles S. Bacon, Jr., Case Institute of Technology, first called attention to the occurrence of this cephalopod fauna and provided supplementary information relative to the collecting localities. His report of 1948 has been used freely in connection with the present study. Identifications of the pelecypods found in association with the cephalopods were made by Dr. Norman D. Newell of The American Museum of Natural History. During the field work of 1949, Mr. Kent H. Wilson, University of Idaho, added materially to the collections. The accompanying photographs were retouched by Mr. Howard Webster of Iowa City, and he also prepared the text figures.

SYSTEMATIC PALEONTOLOGY

MOOREOCERAS CREBRILIRATUM (Girty)
Plate 25, figures 10–16

Orthoceras crebriliratum GIRTY, 1909, U. S. Geol. Surv. Bull. 377, pp. 9, 46, pl. 6, figs. 9–10; GORDON, 1944, Am. Assoc. Petroleum Geol., Bull., vol. 28, p. 1630.

Mooreoceras crebriliratum MILLER and YOUNGQUIST, 1948, Jour. Paleontology, vol. 22, pp. 651, 653, pl. 94, figs. 4, 5; ? YOUNGQUIST, 1949, Jour. Paleontology, vol. 23, pp. 279, 281, 284, pl. 56, figs. 16, 17.

More than 140 specimens that belong in *Mooreoceras* were collected in the Confusion Range, but most of them are very incomplete. Six of the better individuals are illustrated. Nearly all of the specimens (including most of those illustrated) retain portions of the test, which bears very fine transverse lines. The largest individuals approach 40 mm. in length and have a maximum diameter of as much as 22 mm. In all of them the conch is gradually expanded orad, and the camerae, which vary somewhat in length, are considerably shorter than the corresponding diameter of the conch. The cross section is subcircular, and the siphuncle, at its passage through the septa, is small and subcentral. The septal necks, which are slightly but distinctly recurved, are about a fifth as long as the connecting rings, and their diameter is distinctly less than that of those rings. The connecting rings are essentially cylindrical in shape, though their extremities are contracted. In structure, the siphuncle is therefore somewhat like that of *Dolorthoceras*. Two specimens were sectioned, and in both there are deposits around the siphuncle that may well be organic in origin—they are somewhat reminiscent of those in *Pseudorthoceras*. In all available particulars, these specimens seem to agree with the types of the species, which came from the Caney shale of Oklahoma.

Occurrence.—A Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah. Also known from the Barnett shale of central Texas, the Caney shale of Oklahoma, and probably the Moorefield shale of Arkansas and the White Pine shale of Nevada.

Respository.—State Univ. Iowa, 9800 (figured specimens) and 9801.

BACTRITES cf. B. CARBONARIUS Smith
Plate 25, figures 17, 18

Bactrites is exemplified in our Utah collections by 36 fragmentary specimens. All of them represent only one or two camerae, and all seem to belong to a single species. In diameter they vary from about 4 mm. to 10 mm. The conch is essentially circular in cross section, and its rate of adoral expansion appears to have been gradual. The septa are rather strongly convex apicad. The camerae are about two-thirds as long as wide. The siphuncle is ventral and marginal in position.

Of the several known species of *Bactrites* which have conchs that are circular in cross section, the Utah specimens seem to be closest to *B. carbonarius* Smith, first described from the Fayetteville shale of Arkansas and later (1911) identified by Girty from the Moorefield shale of the same state. In typical *B. carbonarius*, as in the Utah individuals, the diameter of the conch is greater than the length of the corresponding camerae, with the ratio being about 3 to 2. No trace of the test is preserved on any of our specimens.

Occurrence.—A Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah.

Repository.—State Univ. Iowa, 9802 (figured specimens) and 9803.

GONIATITES CHOCTAWENSIS Shumard

Plate 25, figures 8, 9; plate 26, figure 16

Goniatites choctawensis SHUMARD, 1863, St. Louis Acad. Sci., Tr., vol. 2, pp. 109–110; SMITH, 1903, U. S. Geol. Surv. Mon. 42, pp. 67–68, 144; GIRTY, 1909, U. S. Geol. Surv. Bull. 377, pp. 9, 10, 54, 56, 58, 59–62, 63, 64, 102, pl. 13, figs. 1–11b; GIRTY, 1911, U. S. Geol. Surv. Bull. 439, pp. 12, 13, 18, 19, 20, 22, 25, 97–99, 100, pl. 15, figs. 1–7; GIRTY, 1915, U. S. Geol. Surv. Bull. 593, pp. 14, 129–130, pl. 5, figs. 4, 5; CRONEIS, 1930, Arkansas Geol. Surv. Bull. 3, pp. 55, 64, 71; GIRTY, 1934, Am. Assoc. Petroleum Geol., Bull., vol. 18, p. 1543; PLUMMER and SCOTT, 1937, Texas Univ. Bull. 3701, pp. 15, 29, 30, 106, 107, 113–114, 381, 383, 384, 399, pl. 7, figs. 3–6; SCHUCHERT, 1943, Stratigraphy of the eastern and central United States, pp. 852, 912; MILLER and YOUNGQUIST, 1948, Jour. Paleontology, vol. 22, pp. 649, 650, 652, 653, 658–660, 661, pl. 95, figs. 16, 17; pl. 96, figs. 1–3, 9–12; pl. 97, figs. 1–21; pl. 98, figs. 1–13; pl. 99, figs. 1–19; YOUNGQUIST, 1949, Jour. Paleontology, vol. 23, pp. 278, 279, 281, 296–299, pl. 62, fig. 7; pl. 63, figs. 1–8; pl. 64, figs. 1–12; MILLER, DOWNS, and YOUNGQUIST, 1949, Jour. Paleontology, vol. 23, pp. 608, 609, pl. 99, figs. 7, 8.

Glyphioceras incisum [part?] HYATT, 1893, Texas Geol. Surv. Ann. Rept. 4, pp. 471–472, pl. 47, figs. 44–48; [part?] SMITH, 1897, California Acad. Sci. Pr., 3rd ser., Geol., vol. 1, pp. 111–112, pls. 13–15; [part?] PLUMMER and MOORE, 1922, Texas Univ. Bull. 2132, pp. 29, 30.

Glyphioceras cumminsi HYATT, 1893, Texas Geol. Surv. Ann. Rept. 4, pp. 467–471, pl. 47, figs. 33–43; [part?] PLUMMER and MOORE, 1922, Texas Univ. Bull. 2132, pp. 29, 30; CLOUD and BARNES, 1948, Texas Univ. Publ. 4621, p. 55.

Goniatites kentuckiensis MILLER, 1889, North American geology and palaeontology for the use of amateurs, students, and scientists, pp. 439–440, text fig. 740; MILLER and GURLEY, 1896, Illinois State Mus. Natur. Hist. Bull. 11, pp. 40–41, pl. 5, fig. 1; SMITH, 1903, U. S. Geol. Surv. Mon. 42, pp. 14, 77, 81, 144, pl. 17, fig. 1; PLUMMER and SCOTT, 1937, Texas Univ. Bull. 3701, p. 114; MILLER and FURNISH, 1940, Jour. Paleontology, vol. 14, pp. 356, 357, 361–363, pl. 46, figs. 1–13; GORDON, 1944, Am. Assoc. Petroleum Geol., Bull., vol. 28, p. 1633; SHIMER and SHROCK, 1944, Index fossils of North America, p. 571, pl. 234, figs. 9, 10.

Goniatites striatus [part] SMITH, 1903, U. S. Geol. Surv. Mon. 42, pp. 14, 15, 62, 63, 66, 67, 68, 69, 70, 77, 79, 80–81, 87, 144, pl. 10, figs. 1–11; pl. 26, figs. 6–13.

Goniatites crenistria [part] SMITH, 1903, U. S. Geol. Surv. Mon. 42, pp. 14, 15, 63, 66, 67, 68–76, 79, 80, 81, 144, pl. 10, figs. 12–16; pl. 14, figs. 1–12; pl. 15, figs. 1–9, pl. 16, figs. 1a–1j; pl. 26, figs. 1–5; CRONEIS, 1930, Arkansas Geol. Surv. Bull. 3, pp. 55, 71; SHIMER and SHROCK, 1944, Index fossils of North America, p. 571, pl. 234, figs. 4, 5.

Goniatites sp. GIRTY, 1918, U. S. Geol. Surv. Prof. Pap. 110, p. 39.

? *Glyphioceras* n. sp. PLUMMER and MOORE, 1922, Texas Univ. Bull. 2132, pp. 29, 44, pl. 7, fig. 12.

Glyphioceras (*Goniatites*) *choctawensis* PLUMMER and MOORE, 1922, Texas Univ. Bull. 2132, pp. 29, 30.

Goniatites subcircularis CRONEIS, 1930, Arkansas Geol. Surv. Bull. 3, pp. 56, 71.

Goniatites newsomi CRONEIS, 1930, Arkansas Geol. Surv. Bull. 3, pp. 56, 71.

Nuculoceras incisum [part] PLUMMER and SCOTT, 1937, Texas Univ. Bull. 3701, pp. 15, 29, 30, 33, 106–108, 109, 113, 383, 384, 399, pl. 7, fig. 10 [not 7–9, 11–14].

Only two specimens in the present collection seem to be referable to *Goniatites* s. s., and both represent early stages of conch development. The individual illustrated by figure 16 on plate 26 is the larger but less well preserved of the two, and a picture of it was included chiefly to show the portion of the test which it retains. The maximum diameter of this specimen is about 7 mm. The better specimen (pl. 25, figs. 8, 9) is approximately $5\frac{3}{4}$ mm. in diameter, and its maximum width and height of conch and depth of impressed zone measure about $5\frac{1}{2}$ mm., $2\frac{3}{4}$ mm., and $1\frac{1}{2}$ mm., respectively. The umbilicus is very small and has a maximum diameter of less than 1 mm. The conch is globular in shape and is very broadly rounded ventrally. The sutures are typical of immature representatives of *Goniatites* s. s., and each one forms a deep steep-sided ventral lobe that is divided by a low ventral saddle which is itself bifid. As would be expected in an immature individual, the height of this saddle increases

materially in successive sutures on the outer volution of this specimen (the one portrayed by figures 8 and 9 on plate 25). The ventral lobe is followed by a large first lateral saddle that is distinctly constricted near its mid-height, inclines slightly ventrad, and is for the most part rounded but at its maximum height is more or less subangular. Its tendency toward angularity becomes progressively increased in succeeding sutures. The first lateral lobe is almost symmetrical and is acuminate. The second lateral saddle is large, broad, and markedly asymmetrical, and it extends to the umbilical shoulder.

A portion of the test is retained on the specimen shown by figure 16 on plate 26, and it bears a reticulate ornamentation in which longitudinal and transverse lirae are of essentially equal prominence. The external ornamentation is faintly but distinctly impressed on the internal mold represented by figures 8 and 9 on plate 25. It appears to differ from that of the original surface (presumably shown by the test of figure 16 on plate 26) only in that the transverse lirae are slightly more prominent than the longitudinal ones.

As would be expected, in general the sutures of these juvenile representatives of *Goniatites* s. s. are not unlike those of similar-sized specimens referable to *Lyrogoniatites* and *Neoglyphioceras*. The differences in the shape of the conch and the size of the umbilicus of specimens of *Goniatites* and *Lyrogoniatites* are considered in our discussion of a new species of the latter genus. It seemed logical to conclude that immature representatives of *Neoglyphioceras* (which has a small umbilicus at maturity, as does *Goniatites*) might also approximate the general form of the two specimens under consideration. In order to establish the affinities of these two specimens, a 13-mm. example of *Neoglyphioceras* was broken back to a size similar to that of the smaller *Goniatites*. Comparable measurements are as follows:

	G. choctawensis	*N. subcirculare*
Maximum diameter of conch	5¾ mm.	5½ mm.
Maximum height of conch	2⅔ mm.	3 mm.
Maximum width of conch	5½ mm.	3¾ mm.
Maximum width of umbilicus	½ mm.	1 mm.

At a comparable diameter, the conch of *Neoglyphioceras* is distinctly narrower and therefore relatively higher than is that of *Goniatites*. Accordingly, the latter has a more globular appearance. Furthermore, the ornamentation that is impressed on the internal mold of *Neoglyphioceras* at a diameter of 5½ mm. consists almost exclusively of longitudinal lirae and striae, and transverse ornamentation can hardly be said to be present. At a comparable size, in *Goniatites* the reverse is approached, that is, the longitudinal ornamentation is less distinct than the transverse. Thus, both the shape of the conch and the ornamentation substantiate the conclusion that the two specimens we are studying are immature representatives of *Goniatites* and not *Neoglyphioceras*.

Occurrence.—A Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah. Elsewhere this species is widely distributed geographically, being known from the White Pine shale of Nevada and California; the Helms and Barnett formations of Texas; the Caney shale of Oklahoma; the Moorefield, Ruddell, Batesville, and Fayetteville formations of Arkansas; and the "Meramec" of Kentucky. In Europe closely related forms occur in the middle and the upper Viséan.

Repository.—State Univ. Iowa, 9804 (figured specimens).

LYROGONIATITES UTAHENSIS M., Y., & N., n. sp.

Plate 25, figures 1–7; plate 26, figures 1, 2, 14, 15

Lyrogoniatites is the largest single generic element in the collection under consideration, where it is represented by 39 reasonably good specimens and more than 165 fragments. All of these seem to be referable to a single undescribed species.

The largest individual is an internal mold of about half a volution of a conch that had a diameter of at least 50 mm. The diameter of most of the specimens ranges from 10 mm. to 20 mm.; but that of several of them is in excess of 40 mm., and these individuals retain half a volution or more of the body chamber.

We are illustrating six specimens and an enlarged portion of the test of a seventh (to show the nature of the external ornamentation). The largest of the six (pl. 25, figs. 6, 7) is designated the holotype. It has a maximum diameter of about 24½ mm. and a corresponding width and height of conch and diameter of umbilicus of about 13½ mm., 9 mm., and 10 mm., respectively. The conch is considerably impressed dorsally, but the umbilicus is open, though apparently imperforate. The umbilical walls are steep. Three prominent sinuous transverse constrictions occur on the outer volution of the holotype. The surface ornamentation of the test (see pl. 25, fig. 5, which represents an otherwise unfigured individual) consists primarily of prominent sharp longitudinal lirae separated by relatively broad shallow striae. The growth lines (which are essentially parallel to the constrictions) are in general transverse to the long axis of the conch but are sinuous, and each forms a broad rounded ventral sinus and on either side of it a similar but more narrowly rounded ventrolateral salient, a broad lateral sinus, and a low salient in the vicinity of the umbilical shoulder. The combination of the longitudinal lirae and striae with the transverse growth lines results in a crenulate ornamentation.

The two specimens illustrated by figures 1, 2, 14, and 15 on plate 26 represent the very early stages of the conch and elucidate certain features of the ontogenetic development in *Lyrogoniatites*. Several other specimens have been broken back to corroborate the observations set forth here. The protoconch is more or less subglobular in shape, but during very early ontogenetic development (that is, within its first two volutions) the conch becomes distinctly wider than high. For example, in the inner volutions of a typical representative of this species at a diameter of about 3¼ mm. (some 4¼ volutions) the conch is about 3 mm. wide and 1¼ mm. high and the umbilicus is approximately 1¾ mm. in diameter. The specimen portrayed by figures 1 and 2 on plate 26 consists of some 4½ volutions and has approximately the following dimensions: maximum diameter 3¾ mm., diameter of umbilicus 2¼ mm., height of conch near adoral end 1¼ mm., and corresponding width of conch 2½ mm. The very small individual represented by figures 14 and 15 on the same plate is about 2 mm. in diameter, the maximum diameter of its umbilicus measures about 1¼ mm., and the height and width of the adoral portion of its conch are about ¼ mm. and 1 mm., respectively. Figure 4 on plate 25 elucidates the shape of the cross section in four volutions, and shows clearly how strongly it is depressed. During early ontogenetic development, the general physiognomy of the conch in at least this species of *Lyrogoniatites* is quite different from that in typical *Goniatites* s. s. In the latter, the immature conch has a distinctly globular shape (see pl. 25, figs. 8, 9) for it is rounded ventrally and has a very small umbilicus. In *Lyrogoniatites* the conch becomes depressed during relatively early ontogenetic development.

On the extreme adapical portion of the conch, the test ornamentation consists entirely of fine transverse growth lines that are slightly sinuous. When the conch has attained a diameter of about 4½ or 5 mm., the longitudinal lirae that are characteristic of the genus make their appearance. In the next half-volution, these lirae are about equal to the growth lines in prominence, and the conch therefore has a reticulate ornamentation which is reminiscent of that of certain representatives of *Goniatites* s. s. In the specimens under consideration, the longitudinal lirae then become increasingly prominent so that they completely overshadow the growth lines (see pl. 25, fig. 5).

At least the external sutures of the holotype (text fig. 1) are similar to those of representatives of *Goniatites* s. s. That is, each forms a deep narrow bifid ventral lobe and on either side of it a large subangular asymmetrical first lateral saddle, an almost symmetrically V-shaped acuminate first lateral lobe, and a broad relatively low asymmetrical second lateral saddle which extends to a small pointed lobe on the umbilical wall.

The internal sutures are not visible on the holotype, but they are elucidated clearly by the fragment represented by figure 3 on plate 25 (see text figure 2). Each consists of a deep narrow straight-sided acuminate dorsal lobe and on either side of it a high rounded U-shaped internal first lateral saddle, an internal first lateral lobe which is similar to the dorsal lobe but is smaller, and

a broad rounded asymmetrical internal second lateral saddle which extends across the umbilical seam.

Remarks.—This species has a considerably smaller umbilicus than such congeneric forms as *L. cloudi* Miller and Youngquist and *L. entogonus* (Gabb). The genotype, *L. newsomi georgiensis* Miller and Furnish, also has a small umbilicus, but the ventral lobe of its sutures is relatively short and broad and the first lateral saddle is less nearly angular. The sutures of the Utah species under consideration are fairly close to those of *Goniatites choctawensis* Shumard as figured by Miller and Furnish (1940, p. 362, fig. 7A) and Miller, Downs, and Youngquist (1949, p. 609, fig. 3A).

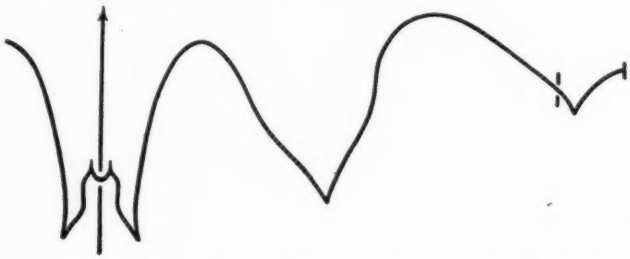


FIG. *1*—Diagrammatic representation of an external suture near the mid-length of the adoral half-volution of the holotype of *Lyrogoniatites utahensis* M., Y., & N., ×5—same specimen as figures 6 and 7 on plate 25.

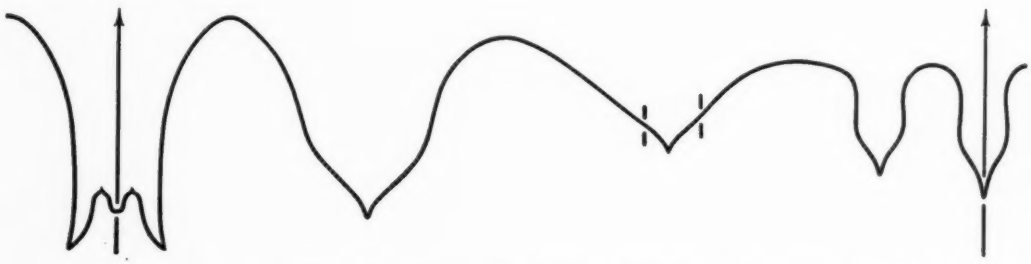


FIG. *2*—Diagrammatic representation of a complete suture of *Lyrogoniatites utahensis* M., Y., & N., based on the mid-portion of the fragment illustrated by figure 3 on plate 25, ×10.

Occurrence.—A Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah.

Repository.—State Univ. Iowa, 9805 (holotype), 9806 (figured paratypes), and 9807.

EXPLANATION OF PLATE 25

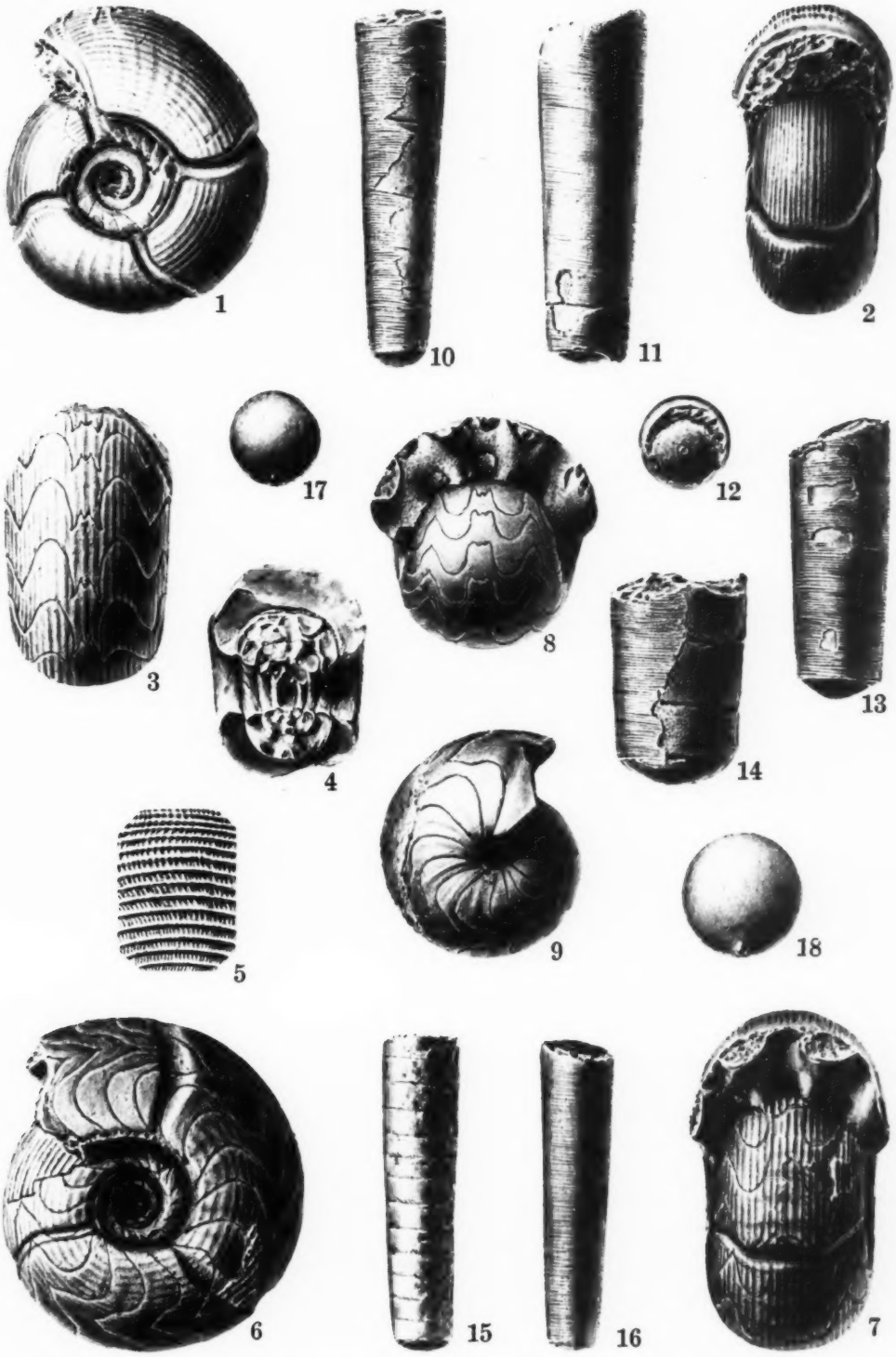
The specimens illustrated on this plate are from a Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah. They have been deposited at the State University of Iowa.

FIGS. *1–7*—*Lyrogoniatites utahensis* M., Y., & N., n. sp. Five specimens. Figs. 1, 2 represent a moderately large individual which retains nearly a full volution of the body chamber, ×2; fig. 3 is a ventral view of a portion of a phragmocone, ×3 (text fig. 2—a diagrammatic representation of a complete suture—is based on this specimen); fig. 4 is a dorsal view of a fragment that elucidates the cross section of four volutions, ×2½; fig. 5 illustrates the surface markings of the test on the ventrolateral portion of the conch at a diameter of some 35 mm., ×2; and figs. 6, 7 represent the holotype, ×2. (p. 154)

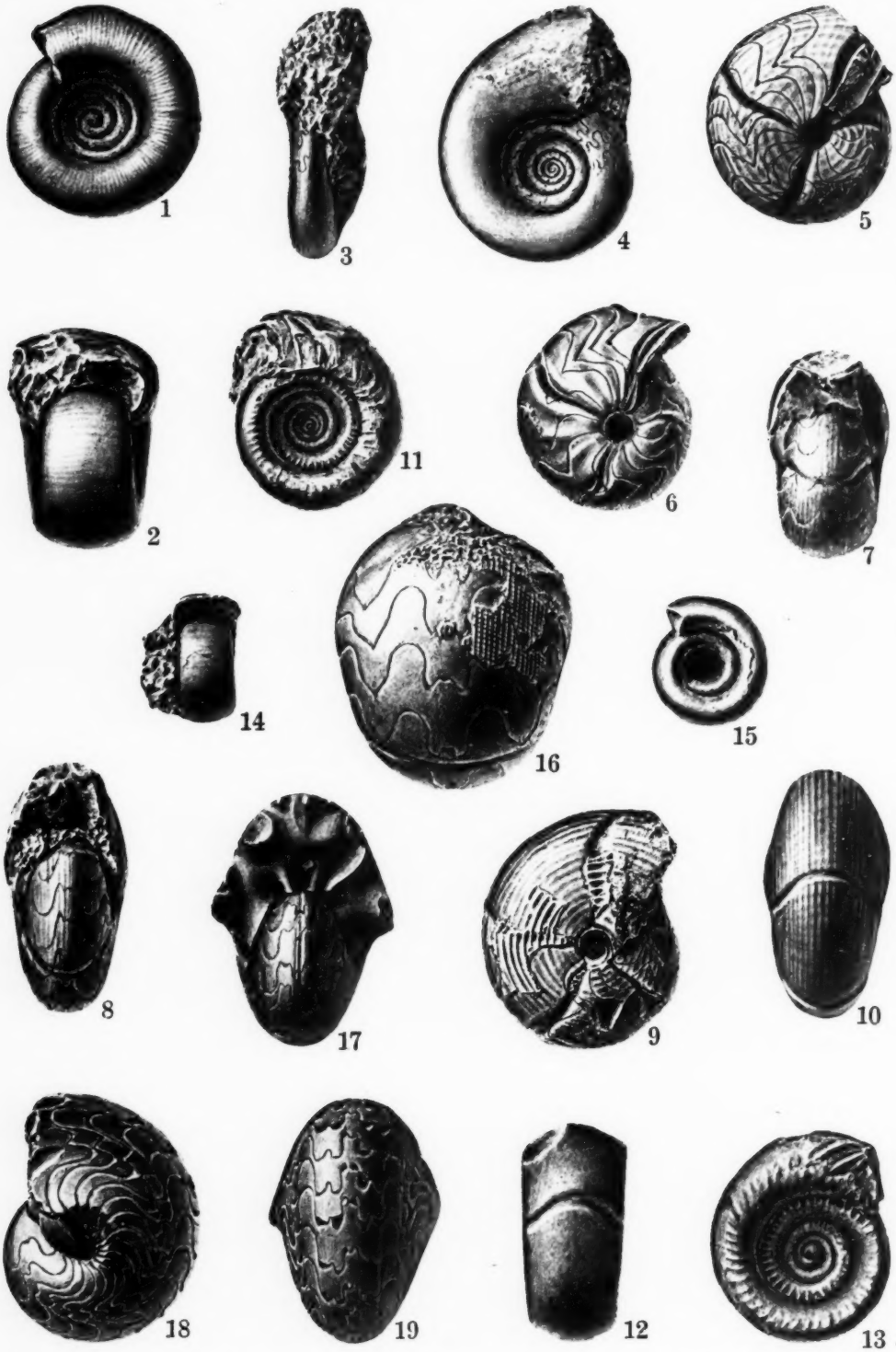
8, 9—*Goniatites choctawensis* Shumard. Two views of an immature specimen, ×6. (p. 153)

10–16—*Mooreoceras crebriliratum* (Girty). Six specimens, ×2 (figs. 10–13), ×2½ (fig. 14), and ×2 (figs. 15, 16). Figs. 11 and 12 represent the same individual. (p. 152)

17, 18—*Bactrites* cf. *B. carbonarius* Smith. Apical views of two specimens, ×3 (fig. 17) and ×2 (fig. 18). (p. 152)



Miller, Youngquist and Nielsen, Mississippian Cephalopods from Utah



Miller, Youngquist and Nielsen, Mississippian Cephalopods from Utah

NEOGLYPHIOCERAS SUBCIRCULARE (Miller)
Plate 26, figures 5–10

Goniatites subcircularis MILLER, 1889, North American geology and palaeontology for the use of amateurs, students, and scientists, p. 440, text fig. 741; SMITH, 1903, U. S. Geol. Surv. Mon. 42, pp. 81–82, pl. 26, figs. 14–18; GIRTY, 1911, U. S. Geol. Surv. Bull. 439, p. 101, pl. 14, figs. 7, 8; BISAT, 1924, Yorkshire Geol. Soc., Pr., n. ser., vol. 20, p. 78; DELÉPINE, 1930, Livre Jubilaire (1830–1930) Soc. géol. France, t. 1, pp. 220, 224, 225, 228; —, 1931, C. R. Cong. Soc. Savantes, Lille, 1928, pp. 134–135; —, 1931, British Assoc. Adv. Sci., Rept. 1930, p. 327; BISAT, 1933, Geol. Assoc., Pr., vol. 44, p. 258; BÖHM, 1935, Études sur les faunes du Dévonien Supérieur et du Carbonifère Inférieur de la Montagne Noire, pp. 148–149, pl. 8, figs. 1a–1c.; DELÉPINE, 1935, Soc. géol. France, Bull., 5e sér., t. 5, pp. 179–180, 185, 186, 187, pl. 7, figs. 14–17; MOORE, 1936, Manchester Geol. Assoc., Jour., vol. 1, p. 184, pl. 1, figs. 3–5, 9; BISAT, 1936, Internat. Geol. Cong., Rept. 16th sess., vol. 1, p. 535; DELÉPINE, 1937, C. R. Deuxieme Cong. l'avanc. études Stratigr. Carbon, Heerlen, 1935, pp. 144, 146; — and MENCHIKOFF, 1937, Soc. géol. France, Bull., 5e sér., t. 7, p. 86.

? *Gastrioceras caneyanum* GIRTY, 1909, U. S. Geol. Surv. Bull. 377, pp. 57–59, pl. 12, figs. 4–10; —, 1911, U. S. Geol. Surv. Bull. 439, pp. 102–103, pl. 14, fig. 6; —, 1915, U. S. Geol. Surv. Bull. 593, p. 131, pl. 5, figs. 6, 6a.

? *Goniatites subcircularis zousfanensis* DOLLÉ, 1912, Soc. géol. Nord. Ann., t. 41, pp. 216–217, pl. 7, figs. 7, 7a.

Lusitanoceras subcirculare PEREIRA DE SOUSA, 1924, Soc. géol. France, Bull., 4e sér., t. 23, p. 304.

Glyphioceras subcirculare [part] SCHMIDT, 1925, Preuss. geol. Landesanstalt, Jahrb., Bd. 45, pp. 572–574, pl. 21, figs. 12, 13; pl. 24, figs. 1–3; —, 1929, Tierische Leitfossilien des Karbon, Gürich's Leitfossilien, Lief, 6, p. 68, pl. 18, fig. 8.

Neoglyphioceras subcirculare PLUMMER and SCOTT, 1937, Texas Univ. Bull. 3701, pp. 116, 186, 187, 381, 383, 399, 401.

? *Neoglyphioceras caneyanum* PLUMMER and SCOTT, 1937, Texas Univ. Bull. 3701, pp. 15, 186, 187, 381, 383.

? *Paragoniatites caneyanus* LIBROVITCH, 1938, Arctic Inst., Tr., vol. 101, pp. 54, 90.

Neoglyphioceras subcirculare MILLER and FURNISH, 1940, Jour. Paleontology, vol. 14, pp. 356, 357, 359, 360–361, pl. 45, figs. 1, 2; pl. 47, figs. 13, 14.

The Utah collection under consideration contains thirteen good and four fragmentary representatives of this species. The largest of them (unfigured) has a maximum diameter of about 17 mm. and the smallest approximately 7 mm.; whereas most are from 10 to 13 mm. in diameter. Some retain the body chamber, and almost all show at least traces of the sutures.

Small individuals are subglobular in shape, but the one with a diameter of 7 mm. is distinctly flattened laterally, as is the 5½-mm. portion of the specimen cited in our discussion of *Goniatites choctawensis*. Specimens with a diameter of 10 mm. and more are subdiscoidal but are rounded ventrally. The one represented by figures 8–10 on plate 26 measures approximately 14 mm. in diameter; the maximum height and width of its conch are about 9 mm. and 6½ mm., respectively; and its umbilicus is small with a diameter of only about 1½ mm. The umbilical shoulders are distinct but rounded, and

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EXPLANATION OF PLATE 26

The specimens illustrated on this plate are from a Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah. They have been deposited at the State University of Iowa.

FIGS. *1, 2*—*Lyrogoniatites utahensis* M., Y., & N., n. sp. Two views of an immature testaceous paratype, ×8. (p. 154)

3, 4—*Epicanites baconi* M., Y., & N., n. sp. Two views of the holotype, ×2½. (p. 160)

5–10—*Neoglyphioceras subcircularis* (Miller). Three specimens. Fig. 5 represents a mature phragmocone (and a very small portion of the body chamber), ×2½; figs. 6, 7 illustrate a completely septate individual, ×4; and figs. 8–10 are three views of an exceptionally well preserved specimen which retains half a volution of the body chamber and portions of the test (or rather a replacement of it), ×2½. (p. 157)

11–13—*Girtyoceras?* sp. Two immature specimens of uncertain affinities, ×4 (fig. 11) and ×6 (figs. 12 and 13, which represent one individual). (p. 158)

14, 15—*Lyrogoniatites utahensis* M., Y., & N., n. sp. Two views of a very small immature specimen, ×10. (p. 154)

16—*Goniatites choctawensis* Shumard. Ventral view of a small septate specimen which retains portions of its test, ×6. (p. 153)

17–19—*Dimorphoceras humphreysi* Youngquist. Three views of a well preserved immature phragmocone, ×6. (p. 159)

the umbilical walls are steep. In the 14-mm. specimen under consideration, about half of the outer volution represents body chamber, the remainder phragmocone with well-preserved sutures. There are five constrictions in the outer volution of this individual. These are very prominent on the lateral zones, but ventrally they become quite shallow. The conch is also marked by a series of very faint transverse sinuous ribs which more or less parallel the constrictions. These are indistinct on the specimen being considered (see pl. 26, figs. 8–10, especially fig. 10) but are somewhat more prominent on the internal molds represented by figures 5–7 on plate 26. As shown by figure 9 on the same plate, the test bears prominent longitudinal lirae separated by relatively broad striae. Also, on the surface of the test there are faint sinuous transverse growth lines. The longitudinal but not the transverse markings are represented on most of the specimens collected.

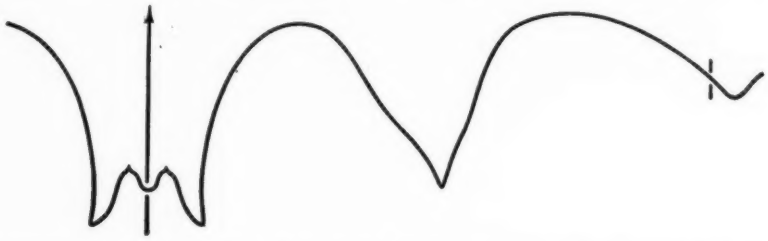

FIG. 3—Diagrammatic representation of the penultimate suture of the representative of *Neoglyphioceras subcirculare* (Miller) illlustrated by figure 5 on plate 26, at a diameter of about 12 mm., ×10.

As shown by text figure 3, each mature external suture forms a rather broad divided ventral lobe and on either side of it a high rounded asymmetrical saddle, a pointed-V-shaped first lateral lobe, and a low broadly rounded second lateral saddle that extends to a small lobe on the umbilical wall. The nature of the internal sutures is not revealed by the material we are studying.

The Utah specimens seem to resemble closely the holotype of this species as illustrated by Miller (1889, p. 440, text fig. 741). Also they appear to be very close indeed to conspecific individuals from the Mississippian of Arkansas illustrated by Smith (1903, pl. 26, figs. 14–18) and Girty (1911, pl. 14, figs. 7–8a).

Occurrence.—A Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah. This species is also known from the "Meramec" of Kentucky, and probably the Caney shale of Oklahoma, the Moorefield and Batesville formations of Arkansas, and the Barnett shale of Texas. Furthermore, various authors have referred to it specimens from the upper Viséan of Belgium and France, Schmidt's Zone IIIγ of Germany, the Mountain limestone of Ireland, the upper *Posidonomya* zone of northern England, and the Viséan of French Morocco and northern Algeria.

Repository.—State Univ. Iowa, 9808 (figured specimens) and 9809.

GIRTYOCERAS? sp.
Plate 26, figures 11–13

The affinities of the two specimens illustrated by figures 11–13 on plate 26, are very uncertain as both of them seem to be immature. The diameter of the specimen represented by figure 11 is about 7½ mm., and that of the individual portrayed by figures 12 and 13 is approximately 5 mm.

The larger of these specimens consists of about 5½ volutions. Except in the immediate vicinity of the protoconch, the first five whorls are considerably depressed and have almost angular umbilical shoulders and broad rather gradually sloping umbilical walls. In the adoral half-volution, the conch becomes flattened laterally. In all of the whorls, the conch is only moderately impressed dorsally. The specimen is largely testaceous and on the umbilical shoulders (and immediately adjacent areas) there are sharp curved ribs which are concave toward the aperture. Slightly ventrad of the umbilical shoulders, these ribs grade into sinuous

growth lines which form shallow narrow ventral sinuses and larger rounded ventrolateral salients that merge laterally with the umbilical ribs. Both the test and the internal mold bear constrictions, of which there are about three to the volution. Otherwise the internal mold is essentially smooth, though faint traces of the growth lines and the umbilical ribs can be discerned on it. There is not more than a suggestion of longitudinal ornamentation, with the exception of a shallow narrow median groove on the venter of the ultimate volution of the larger specimen. This structure is not very prominent on the adapical portion of this volution, and it is not present on the more immature specimen shown in ventral view by figure 12 on plate 26.

The general shape of the conch and particularly the ribs on the umbilical shoulders might be taken to indicate that the affinities of these specimens are with certain members of the Gastrioceratidae. However, they are also reminiscent of the immature stages of *Girtyoceras* as figured by Girty (1909, pl. 12, figs. 3–3b), and the faunal associations are quite in harmony with that indication. Nevertheless, it should be emphasized that we regard the generic reference as very questionable.

Occurrence.—A Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah.

Repository.—State Univ. Iowa, 9810 (both specimens).

DIMORPHOCERAS HUMPHREYI Youngquist
Plate 26, figures 17–19

Dimorphoceras humphreyi YOUNGQUIST, 1949, Jour. Paleontology, vol. 23, pp. 613, 614–615, pl. 100, figs. 8–11.

The collection under consideration contains only a single specimen that belongs in *Dimorphoceras*. It represents an immature portion of a phragmocone. However, the details of the sutures are shown clearly, and also a few traces of the growth lines are present. The specimen is about 6 mm. in diameter and has a maximum width of approximately 4 mm. The conch is impressed dorsally, the whorls are helmet-shaped in cross section, and the umbilicus is small and imperforate.

From the adapical to the adoral end of the outer volution of this specimen, the sutures show a progressive and material change in their details. Therefore, we are reasonably certain that only the immature portion of the conch is represented.

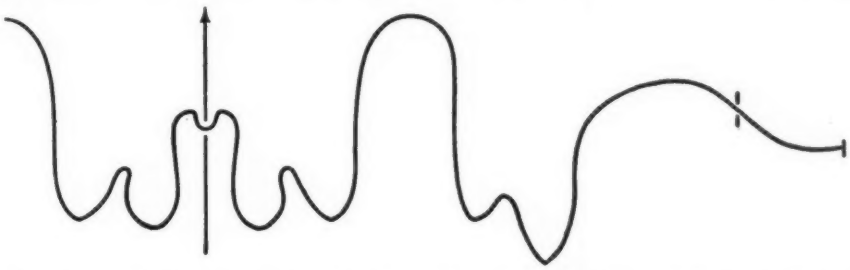

FIG. 4—Diagrammatic representation of an external suture of *Dimorphoceras humphreyi* Youngquist at a diameter of about 6 mm., ×20—same specimen as figures 17–19 on plate 26.

Text figure 4 is based on the adoral portion of the specimen. It shows that each suture there forms a very broad steep-sided divided ventral lobe with asymmetrically bifid prongs. The first lateral saddles are U-shaped; the first lateral lobes are asymmetrically bifid; and the second lateral saddles, which extend to rounded lobes on the umbilical wall, are low, broadly rounded, and asymmetrical. This suture differs only in detail from those of the holotype of *D. humphreyi*, which attains a diameter of some 12 mm. That is, in the Utah specimen the secondary and tertiary saddles in the ventral lobe are relatively small, and those in the first lateral lobe are less nearly angular, presumably because we are dealing with a somewhat earlier stage of development. It should be mentioned that the prongs of the ventral lobe become bifid at about the same stage of ontogenetic development as does the first lateral lobe.

Faint traces of the growth lines preserved on the adapical portion of the specimen under consideration indicate that they are strongly sinuous. Each seems to form a broad shallow ventral sinus and on either side of it a fairly high broad lateral salient, followed by a small shallow sinus, and then a small low rounded salient which extends to the umbilical shoulder.

Occurrence.—A Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah. The species also occurs in the White Pine shale of Nevada; and a closely similar form, *D. pseudodiscrepans* Moore, has been described from the P_1 zone in the lower portion of the upper Viséan of England.

Repository.—State Univ. Iowa, 9811.

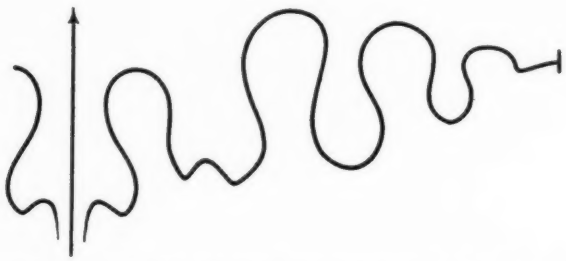

FIG. 5—Diagrammatic representation of the penultimate suture of the holotype of *Epicanites baconi* M., Y., & N., ×24—same specimen as figures 3 and 4 on plate 26.

EPICANITES BACONI M., Y., & N., n. sp.
Plate 26, figures 3, 4

The genus *Epicanites* is represented in the collection we are studying by only a single specimen, which, however, is a well preserved individual of about six whorls. Almost all of the outer volution of this individual represents body chamber. The diameter of the specimen measures about 14 mm. and the maximum width approximately 4 mm. The umbilicus is some 5½ mm. in diameter, and the protoconch is clearly visible. The conch is only moderately expanded orad. Its juvenile portions are subcircular in cross section, being very slightly impressed dorsally. During later ontogenetic development, the conch becomes flattened laterally and the dorsal impressed zone deepens. No trace of the growth lines can be discerned on this individual, but the adoral third-volution of it exhibits faint but nevertheless distinct ribs that form moderately high narrow lateral salients and broad deep ventral sinuses.

As shown by text figure 5, each external suture consists of a rather large trifid ventral lobe and on either side of it a relatively small rounded club-shaped first lateral saddle (that is inclined to the long axis of the conch), an asymmetrically bifid first lateral lobe (that is also inclined), a second lateral saddle that is similar to the first but is much higher and larger, a second lateral lobe that resembles the preceding saddle but is smaller and narrower, a third lateral saddle that is also club-shaped and is relatively low and broad, a similar third lateral lobe that resembles the second but is much smaller, a low rounded asymmetrical fourth lateral saddle, and a small subangular asymmetrical fourth lateral lobe. This suture is in general similar to that of the type species of *Epicanites*, *E. sandbergeri* (Schmidt) of the upper Viséan of Algeria, in which, however, the first lateral lobe is not divided.

Remarks.—Insofar as shape of conch and diameter of umbilicus are concerned, this Utah species closely resembles other typical representatives of *Epicanites*. However, its sutures are somewhat more strongly sinuous than are those of such forms as *E. loeblichi* Miller and Furnish and *E. sandbergeri* (Schmidt), and it is the only known representative of the genus in which the first lateral lobes are bifid. In the last respect, the sutures of the new species approach those of *Pronorites* and *Stenopronorites*. Furthermore, the ribs on *E. baconi* suggest a relationship to *Stenopronorites*. However, all of the lateral lobes of the sutures but the first

are rounded, the umbilicus is very wide, and the whorls are rather low, showing that the affinities of this form are with *Epicanites* and not *Pronorites* or *Stenopronorites*.

Occurrence.—A Meramec shale 4–5 miles east-southeast of Cowboy Pass in the Confusion Range of central western Utah.

Holotype.—State Univ. Iowa, 9812.

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JOURNAL OF PALEONTOLOGY, VOL. 26, NO. 2, PP. 162–174, PLS. 27–28, 4 TEXT FIGS., MARCH 1952

SALEM OSTRACODA OF MISSOURI

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ABSTRACT—Twenty-four species and varieties of Ostracoda are described from the Salem limestone (Mississippian) of St. Louis County, Missouri. Fifteen species and three varieties are new, and one previously described species is newly recorded from the Salem. These are assigned to four families (Glyptopleuridae, Hollinellidae, Graphiadactyllidae and Kirkbyidae) and ten genera including two new ones: *Brillius* (Kirkbyidae) and *Editia* (Kirkbyidae). Criteria for the orientation of Ostracoda are listed. The strata from which the specimens were collected are described.

INTRODUCTION

THE Salem or Spergen limestone of the Meramec series (Middle Mississippian) crops out in a more or less continuous belt on the east, south and west sides of the Illinois basin. Its typical occurrence is in Indiana from which the ostracode fauna was described by Geis in 1932. In Missouri this formation is exposed in the eastern part of the state from Lincoln County to Sainte Genevieve County.

The specimens described here were collected from an exposure, about 100 yards long, on the west side of Missouri highway 21 about one-fourth mile north of Meramec River bridge in St. Louis County, Missouri. Figures 1 and 2 illustrate the strata at this outcrop. The following detailed section starts 4 feet north of the mark "38–800" painted in white on the east side of the road. The colors of the rocks correspond with those of the rock color chart prepared by the National Research Council.

Bed No.	Description	Thickness Feet	Thickness Inches
Top of section			
6	Limestone, semi-hard, much weathered, cross-bedded, fine- to medium-grained, crystalline, very pale to dark yellowish-orange, chert nodules in the basal one foot, fossiliferous	4+	
5	Clay, dark brown		2–3
4	Limestone, hard, well stratified, cross-bedded, fine- to medium-grained, crystalline, very pale orange to dark yellowish-orange, very fossiliferous with *Rhynchonella*	1	8
3	Limestone. At bottom, 1 inch of brown calcareous clay. In middle, coarse-grained, dark yellowish-orange, loosely cemented coquina; very fossiliferous, *Endothyra* and *Bairdia* abundant. At top, very fine-grained to silty, friable, grayish-orange, very fossiliferous with numerous ostracodes		11
2	Limestone, hard, well stratified, coarse- to very coarse-grained, crystalline, slightly lighter colored than bed 0. A thin weathered parting in middle. Very fossiliferous with *Rhynchonella* in the upper part	1	10
	Offset 13 feet south		
1	Limestone, friable, very fine-grained to silty, very pale-orange to dark yellowish-orange. At top, 6 inches of dark-brown calcareous clay. In middle, few layers of hard limestone less than one inch thick	2	6
0	Limestone, hard, massive, coarse- to very coarse-crystalline, pale yellowish-brown to dark yellowish-orange, fossiliferous	1	10+
	Section begins at road level		
	Total	13+	

These beds probably were deposited in shallow neritic marine environment. They are characteristically cross-bedded, more or less lenticular and broken shells are numerous.

Ostracodes may be collected easily from the friable, fossiliferous limestones of bed No. 3. They are not easily extracted from

the harder layers but some specimens may be obtained from the weathered material lying on the tops of slabs and in depressions in these beds.

The type specimens have been deposited in the collections of the Geology Department of Saint Louis University, Saint Louis, Missouri.

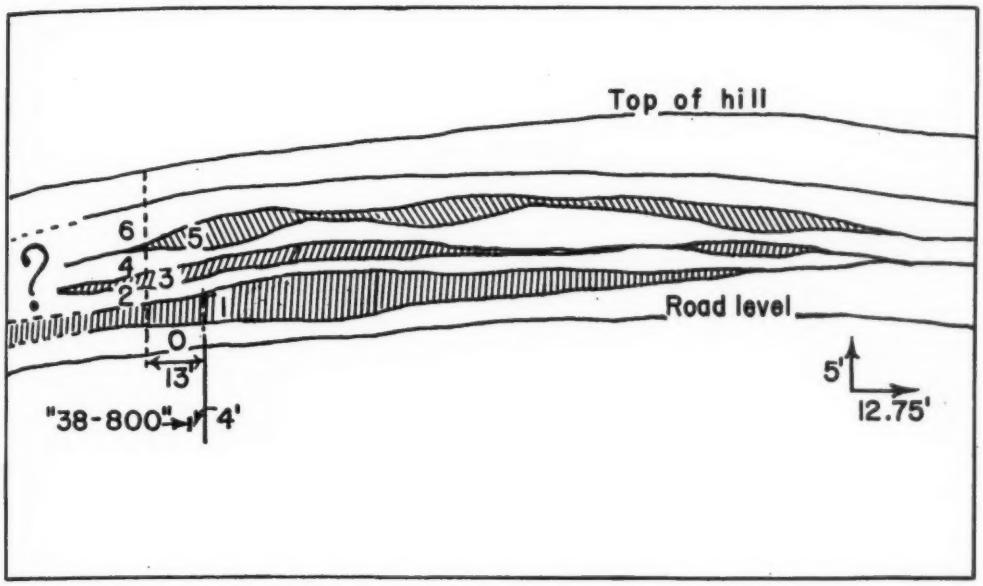


FIG. 1—Diagram of the exposure where the ostracode fauna was collected.

ACKNOWLEDGMENTS

The writer is deeply indebted to Dr. Kenneth G. Brill, Jr., of Saint Louis University for his aid in collecting the ostracodes described in this paper and for his continuous encouragement and advice during this study. Dr. Victor T. Allen and Mr. F. E. Moore gave invaluable assistance in photographing the specimens. Mrs. Betty Kellett Nadeau, Dr. N. S. Hinchey and Dr. A. J. Frank contributed many useful suggestions. The Geology Department of the University of Illinois kindly lent Geis' type specimens for comparison.

ORIENTATION

The literature shows that there is much uncertainty regarding the orientation of Paleozoic ostracodes. Below are listed criteria, largely compiled from suggestions by Geis (1932) and Levinson (1950), that the author has used to determine orientation.

Hingement: Hingement more developed at anterior end.

Anterior hinge component tends to be more rounded than the posterior.

Posterior hinge component tends to be more oblique to dorsal margin than the anterior.

Spines: Major spines directed posteriorly.

Thickness: Posterior most inflated.

Posterior part of female thicker than in male.

Posterior part becomes progressively thicker from youth to adult.

Pit, sulcus, muscle scar: Principal pits, sulci and muscle scars are anterior.

Shape: Rhomboidal specimens have:

Obtuse antero-dorsal angle.

Postero-ventral truncation.

SYSTEMATIC DESCRIPTIONS

Order OSTRACODA Latreille, 1802

Family GLYPTOPLEURIDAE Girty, 1910

Genus GLYPTOPLEURA Girty, 1910

GLYPTOPLEURA PARVACOSTATA Geis, 1932

Plate 27, figures 1 a–c

Glyptopleura plicata CORYELL and BLACKMIER (not Jones and Kirkby) 1931, Am. Midland Naturalist, vol. 12, p. 511, pl. 1, figs. 7, 7a, 7b.

Glyptopleura parvacostata GEIS 1932, Jour. Paleontology, vol. 6, p. 171, pl. 22, figs. 9a–d, pl. 25, figs. 2a–d.

Three typical specimens are present in

the collection. Four others differ by being smaller, having the major ridge closed posteriorly and the marginal ridge obsolete.

GLYPTOPLEURA ELEPHANTA Brayer, n. sp.
Plate 27, figures 2 a–e

In side view subrhomboidal; dorsal margin straight; ventral margin straight to flatly rounded; anterior end well rounded ventrally, gently rounded dorsally, forming obtuse angle with dorsum; posterior end gently rounded dorsally, truncated ventrally. Uniformly high or slightly higher posteriorly. In dorsal view cuneate; posterior end blunt; anterior end sharp; sides straight. Maximum thickness at posterior end of ventral limb of primary ridge. Carapace compressed antero-dorsally. Flat specimens elliptical, posterior ends not blunt, maximum thickness slightly postero-ventral.

A subcentral pit is slightly antero-dorsal to center. A second pit lies above and slightly anterior to the first. Three very sharp ridges are present. A submarginal ridge originates anterior to postero-cardinal angle, extends forward parallel to hinge, parallels anterior and ventral borders and disappears below the middle of posterior end. A second ridge originates in dorsal part of postero-dorsal quarter of valve, extends between pits, curves posteriorly at a point slightly below middle of anterior end of valve, continues postero-dorsally, ends abruptly slightly behind and below center of posterior half of valve. A shorter ridge lies below lower limb of the last. A series of fine spines closely parallels the free edge outside of ridge.

Hinge straight, impressed, almost equalling greatest length of valve, details uncertain. Internal swellings correspond to external pits.

Holotype.—S.L.U. No. 1001; length: 0.94 mm.; height: 0.59 mm.; thickness: 0.63 mm.

Paratypes.—S.L.U. No. 1002.

This species presents two varieties, an inflated form (probably fertile female) and a thin one (probably male). Four specimens of each have been collected. In the thin variety the short ventral ridge is absent or poorly developed. One specimen has two major spines, the first posterior to the cardinal angle and the other above the middle of the anterior end.

GLYPTOPLEURA BELPHEGORA Brayer, n. sp.
Plate 27, figure 3

In side view elongate subovate; dorsal and ventral margins straight; anterior end well rounded, slightly flattened dorsally; posterior end gently rounded dorsally, truncated ventrally. Maximum height at postero-cardinal angle. In dorsal view subcuneate; posterior end blunt; anterior sharp. Maximum thickness slightly postero-dorsal to center of postero-dorsal quarter of shell.

A pit lies antero-dorsal to center of valve. A second is above and slightly anterior to the first. A closed elliptical ridge is very slightly inclined to the long axis of valve. Its anterior is rounded and its posterior deflected dorsally and truncated ventrally.

EXPLANATION OF PLATE 27

(All figures ×27)

FIGS. *1a–c—Glyptopleura parvacostata* Geis, a, dorsal view of small left valve; b, right valve of small specimen; c, right valve of large specimen. (p. 163)

2a–e—Glyptopleura elephanta Brayer, n. sp., a, dorsal view of inflated right valve; b, inflated right valve; c, dorsal view of thin right valve; d, thin left valve; e, right valve with spines. (p. 164)

3—Glyptopleura belphegora Brayer, n. sp., left valve. (p. 164)

4a–c—Glyptopleura sabota Brayer, n. sp., a, dorsal view of holotype; b, right valve of holotype; c, left valve of paratype. (p. 168)

5a–c—Glyptopleura genevievea Brayer, n. sp., a, dorsal view; b, right valve; c, left valve with a supplementary pit. (p. 167)

6—Glyptopleura brunoa Brayer, n. sp., right valve. (p. 168)

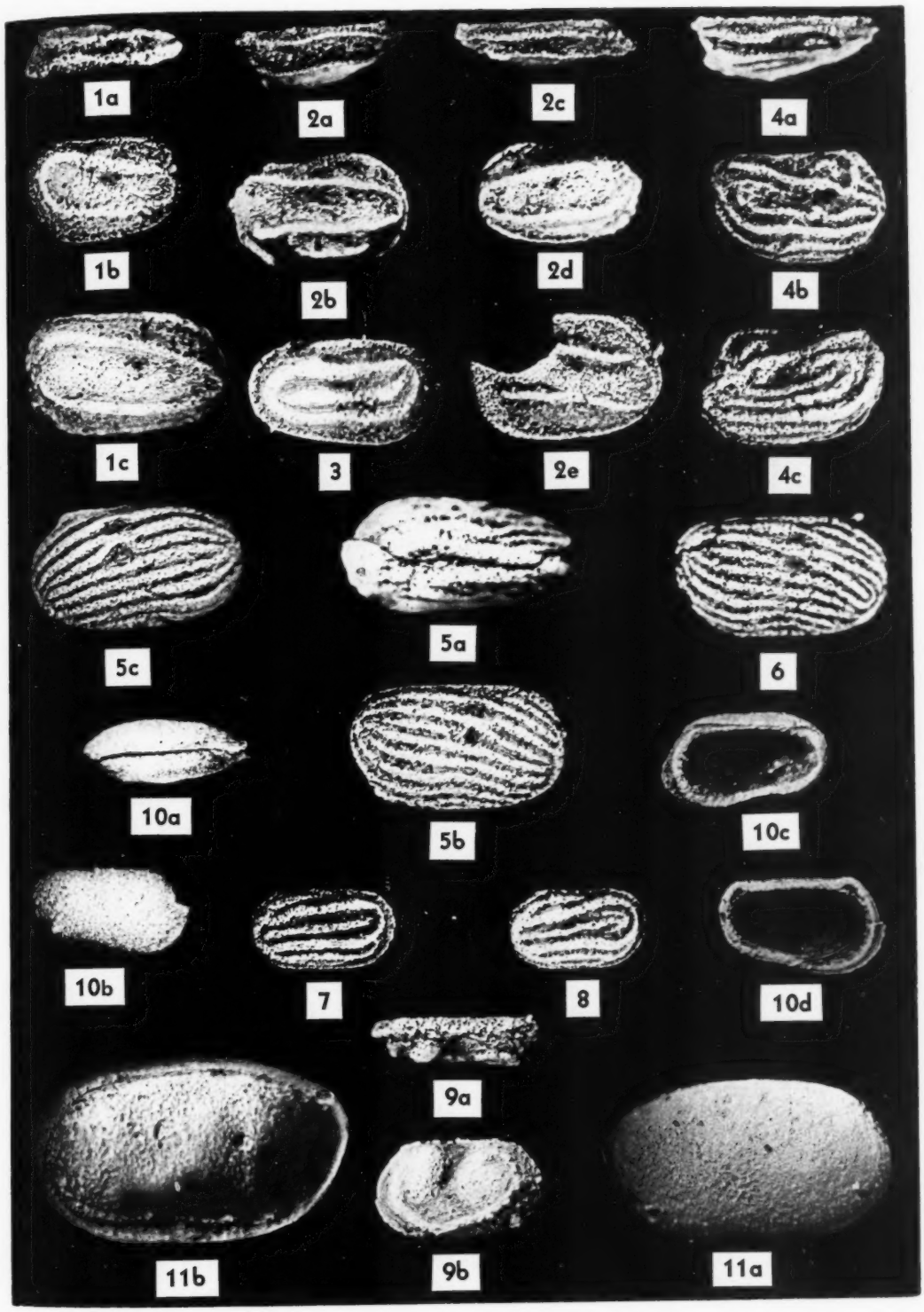
7—Glyptopleura michaelis Brayer, n. sp., left valve. (p. 165)

8—Glyptopleura zara Brayer, n. sp., left valve. (p. 165)

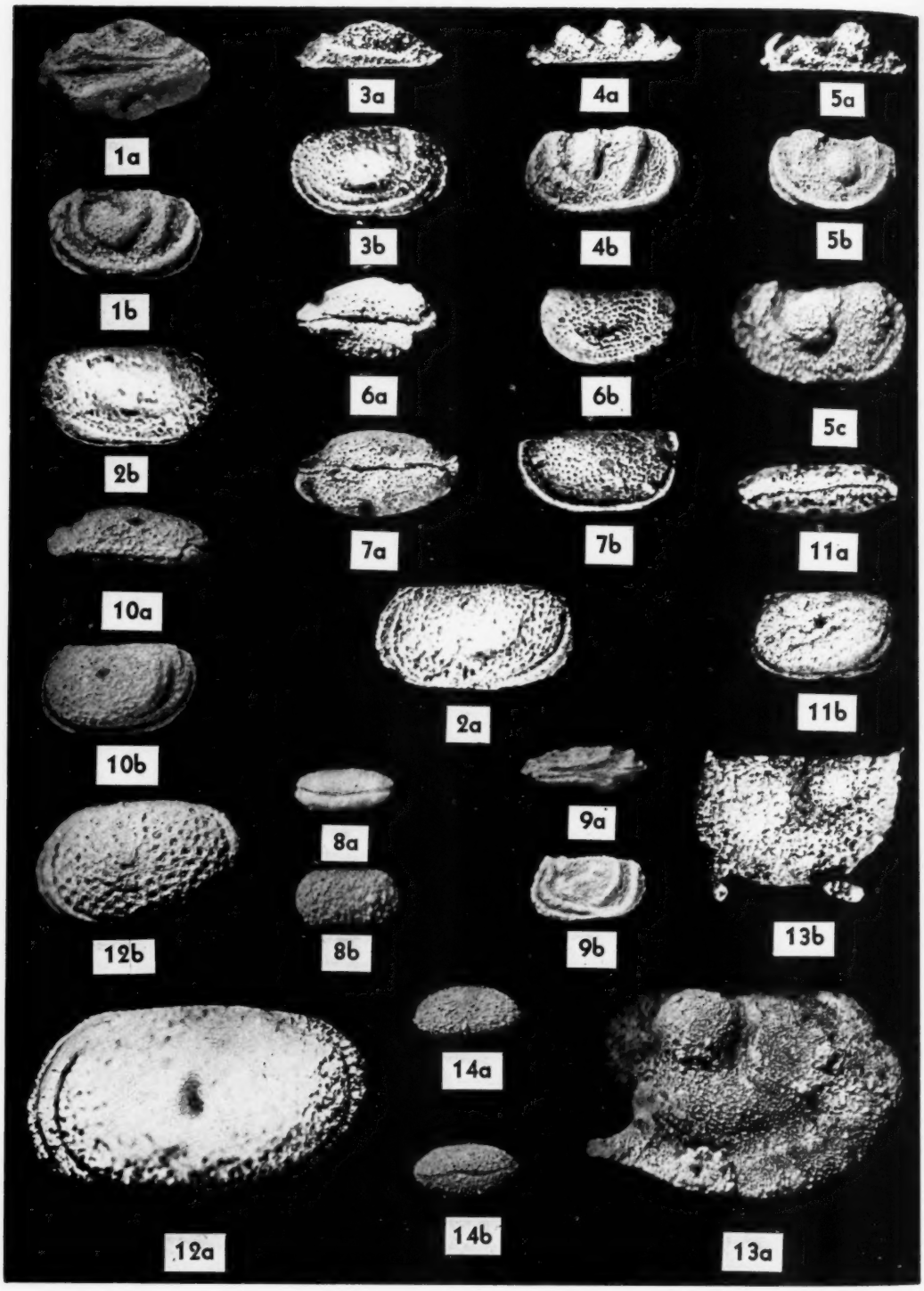
9a–b—Glyptopleurina embryonicia Brayer, n. sp., a, dorsal view of left valve; b, left valve. (p. 168)

10a–d—Graphiadactyllis axea Brayer, n. sp., a, dorsal view; b, right valve; c, internal view of right valve; d, internal view of left valve. (p. 169)

11a–b—Cavellina glandella (Whitfield), a, right valve; b, internal view of right valve.



Brayer, Mississippian Ostracoda of Missouri



Brayer, Mississippian Ostracoda of Missouri

The upper limb extends between the pits. Another ridge lies inside the elliptical one with its posterior end curving slightly upward. A third submarginal ridge parallels the contact of the valve except for a short distance below antero-cardinal angle. A spine rises from this ridge antero-ventrally. Other very fine spines seem to be scattered over surface.

Hinge straight, impressed, almost as long as shell. A rim occurs along free edge of left valve. External pits impressed on the interior.

Holotype.—S.L.U. No. 1003; length: 1.04 mm.; height: 0.59 mm.; thickness: 0.52 mm.

Only one left valve has been collected.

GLYPTOPLEURA MICHAELIS Brayer, n. sp.
Plate 27; figure 7

In side view oblong; ventral and dorsal margins straight, parallel; anterior end well rounded ventrally, gently rounded dorsally; posterior end gently rounded dorsally, truncated ventrally. In dorsal view subcuneate; anterior end sharp; posterior end somewhat blunt. Maximum thickness ventral. Carapace compressed toward antero-cardinal extremity.

A pit lies slightly antero-dorsal to center. A second pit is slightly anterior and above the first. A ridge follows entire border of shell but is wider and flatter at posterior end. A second flat-sided ridge forms an ellipse nearly as long as valve. It is truncated postero-ventrally and its dorsal limb passes between the pits. A short ridge originates anteriorly from the dorsal limb of elliptical ridge, parallels it and dies out slightly behind dorsal pit. A long ridge lies within the elliptical one. Another ridge originates at anterior end of ventral limb of elliptical ridge and divides slightly behind this point. The upper branch extends below and parallel to ventral limb of elliptical ridge, ends level with midpoint of truncated part of elliptical ridge. The lower branch parallels the other and ends a little behind middle of carapace.

Hinge straight, impressed, three-fourths as long as valve. Two minute teeth present at the cardinal angles of left valve. External pits reproduced internally.

Holotype.—S.L.U. No. 1004; length: 0.81 mm.; height: 0.43 mm.; thickness: 0.39 mm.

Paratype.—S.L.U. No. 1005.

Five specimens have been collected. This species is very close to *G. karli* Geis and the costae are identical but it possesses a supplementary pit and is more elongated and less rhomboidal.

GLYPTOPLEURA ZARA Brayer, n. sp.
Plate 27, figure 8

This species is closely related to *G. michaelis* but differs from it as follows:

Definitely cuneate in dorsal view.

Maximum thickness postero-ventral to center of posterior half.

Posterior termination of straight ridge within elliptical ridge bifurcates posteriorly and these branches curve forward parallel to enclosing elliptical ridge.

EXPLANATION OF PLATE 28

(All figures ×27.)

FIGS. *1a–b—Amphissites nodosulcatus* Geis, a, dorsal view; b, left valve. (p. 172)
2a–b—Amphissites mimicus Geis, a, left valve of first specimen; b, right valve of second specimen. (p. 173)
3a–b—Amphissites vanniae var. *missouriensis* Brayer, n. var., a, dorsal view of left valve; b, left valve. (p. 173)
4a–b—Amphissites altonodosus var. *missouriensis* Brayer, n. var., a, dorsal view of left valve; b, left valve. (p. 173)
5a–c—Amphissites armatus Brayer, n. sp., a, dorsal view of left valve; b, right valve; c, large left valve. (p. 173)
6a–b—Amphissites rotundus var. *missouriensis* Brayer, n. var., a, dorsal view; b, right valve. (p. 173)
7a–b—Kirkbya penichea Brayer, n. sp., a, dorsal view; b, right valve. (p. 172)
8a–b—Roundyella simplicissima (Knight), a, dorsal view; b, side view. (p. 172)
9a–b—Editia elegantis Brayer, n. sp., a, dorsal view; b, left valve. (p. 170)
10a–b—Brillius distortus Brayer, n. sp., a, dorsal view; b, left valve. (p. 171)
11a–b—Brillius yveus Brayer, n. sp., a, dorsal view; b, left valve. (p. 171)
12a–b—Savagella lindahli (Ulrich), a, extraordinarily large left valve; b, normal left valve. (p. 170)
13a–b—Hollinella swania Brayer, n. sp., a, right valve of holotype; b, left valve of a young molt. (p. 169)
14a–b—Microcheilus distortus Geis, a, left valve; b, dorsal view.

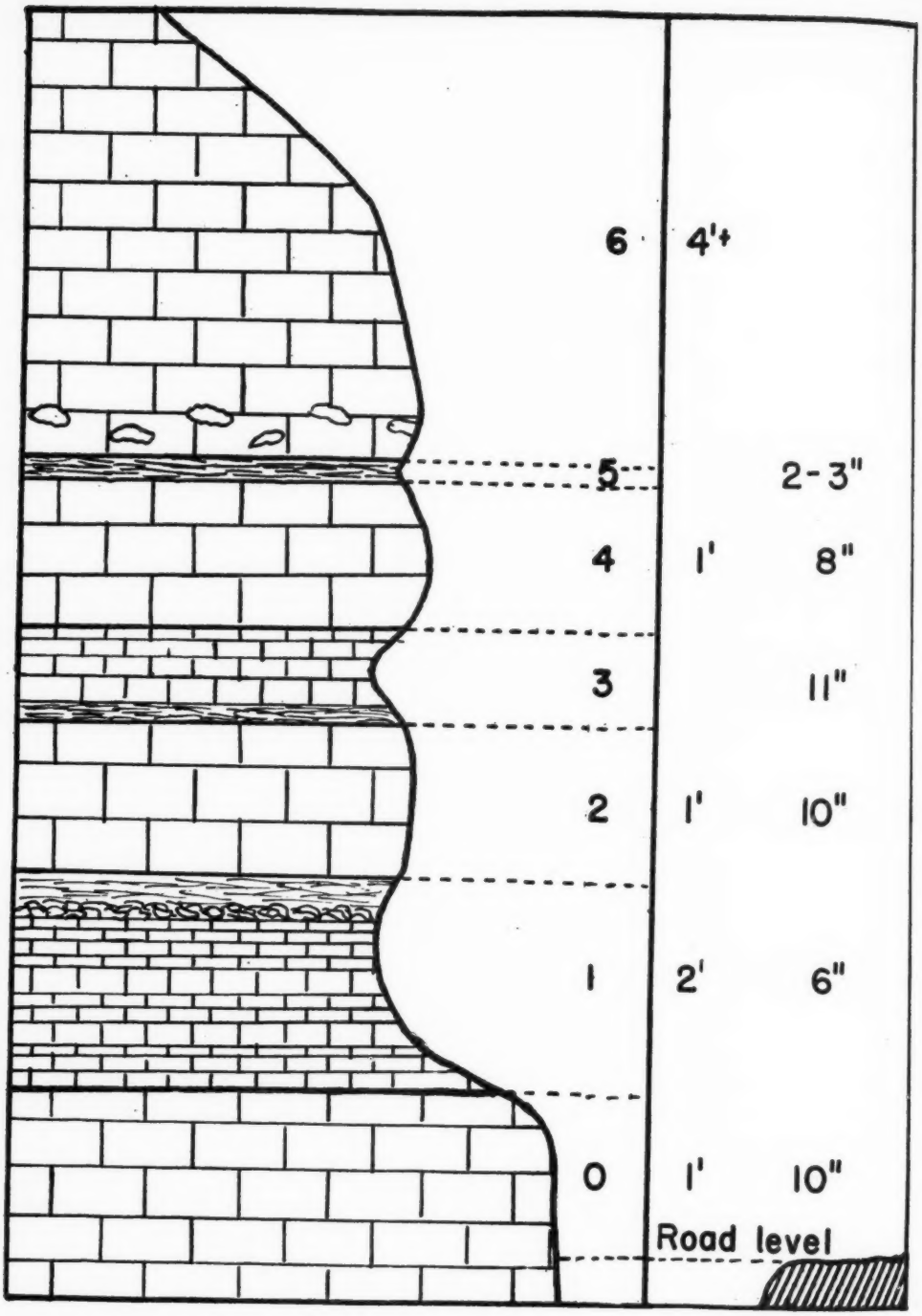


FIG. 2—Profile view of the exposure where the ostracode fauna was collected.

Branches of ridge below elliptical ridge join posteriorly.

Holotype.—S.L.U. No. 1006; length: 0.78 mm.; height: 0.43 mm.; thickness: 0.42 mm.

Two specimens of this species have been collected. The posterior end of the straight ridge within the elliptical ridge is similar to that of the variety of *G. karli* mentioned by Geis.

GLYPTOPLEURA GENEVIEVEA Brayer, n. sp.
Plate 27, figures 5 a–c

In side view oblong rhomboidal; dorsal and ventral margins straight, parallel; anterior end well rounded ventrally, straight dorsally; posterior end truncated ventrally, gently rounded dorsally; both forming obtuse angles with dorsum. In dorsal view elongated to subcuneate; anterior end sharp; posterior end slightly blunt. Maximum thickness slightly antero-ventral to center of posterior half.

A pit lies anterior to and slightly above center. A second pit occurs above and slightly anterior to first (see fig. 3). In right valve a wide rib (1) closely parallels hinge and free edge except at antero-cardinal angle. It is widest ventrally. In left valve, a similar rib marks dorsal and antero-dorsal borders, but elsewhere is obsolete or reduced to a minute rim. Other ribs are identical in the two valves. A submarginal rib (2) parallels the marginal rib and divides antero-dorsally to form a short rib (2a). A third rib (3) is closed subelliptically, passes between the pits and coalesces with rib 2 antero-ventrally. Inside the last are three ribs (4, 5 and 6). Rib 4 is short and lies behind the lower pit. Rib 5 extends the length of the ellipse. Rib 6 lies below the last, which it joins anteriorly and curves backward and joins rib 3 between the pits. Ventrally two other ribs lie between numbers 2 and 3; at both ends they join rib 2.

Hinge straight, impressed, almost as long as shell. Two cardinal teeth in right valve fit into sockets in left. Right valve strongly overlaps left along free edge where high rim of left valve fits into a marginal depression in the other. External pits evident internally.

Holotype.—S.L.U. No. 1007; length: 1.25 mm.; height: 0.71 mm.; thickness: 0.59 mm.

Paratypes.—S.L.U. No. 1008.

This species is closely related to *G. perbella* Geis but is less rhomboidal and more elongated, has wider ribs, the lower ribs are less straight posteriorly, and an extra rib adjacent to number 7 in *G. perbella* is not developed.

Eighteen specimens in the collection show a considerable range in variability as follows:

In width and roundness of ribs.

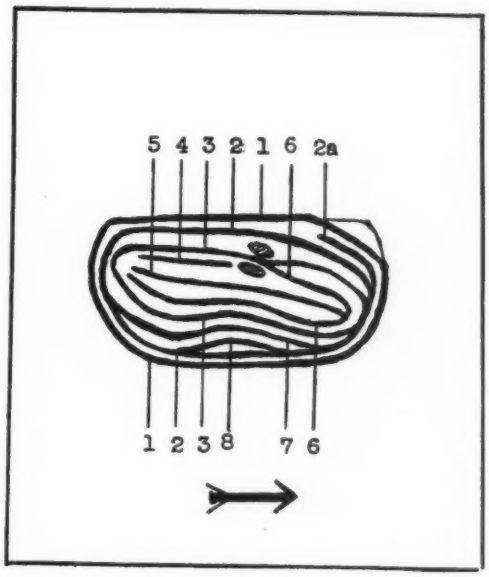


FIG. 3—Diagram of *Glyptopleura genevievea* in side view.

In the posterior coalescence of ribs 2 and 3.

In the coalescence of ribs 3 and 4 behind the pits.

In the anterior coalescence of the upper and lower parts of rib 6 and rib 5.

In dorsal outline.

A single specimen differs from the holotype as follows:

A third pit is present on lower part of rib 2 close to ventral margin and slightly behind mid-line.

The intermittent development of rib 1 and its coalescence with rib 2a below antero-cardinal angle.

The posterior coalescence of ribs 2 and 3.

The coalescence of ribs 3 and 4 just behind the pits.

The anterior ends of the upper and lower parts of ribs 6 and 5 are free.

GLYPTOPLEURA BRUNOA Brayer, n. sp.
Plate 27, figure 6

This species differs from the holotype of *G. genevievea* as follows:

A spine is present at antero-cardinal angle.

The ellipse of rib 3 is not closed antero-ventrally.

The lower part of rib 6 is much shorter and free anteriorly.

The anterior end of rib 5 curves upward and backward around the free end of the upper part of rib 6.

Holotype.—S.L.U. No. 1009; length: 1.23 mm.; height: 0.67 mm.; thickness: 0.59 mm.

The only specimen is broken at the postero-cardinal angle.

GLYPTOPLEURA SABOTA Brayer, n. sp.
Plate 27, figures 4 a–c

In side view subrhomboidal; dorsal margin straight, slightly deflected dorsally at posterior end; ventral margin straight; anterior end rounded ventrally, straight dorsally forming obtuse angle with dorsum; posterior end straight to slightly rounded dorsally, truncated ventrally. Maximum height midway between the anterior and midline of valve. In dorsal view cuneate; posterior end blunt; anterior sharp. Maximum thickness slightly antero-dorsal to center of postero-ventral quarter of shell; compressed antero-dorsally.

A pit lies a little before and above center of valve. A second occurs slightly above and anterior to the first. A rib marks margin of valve and encloses two concentric ribs, both open behind. The inner one passes between pits. Concentric ribs are joined antero-dorsally by vertical rib which also possesses a short anteriorly directed branch. A short crescentic rib occurs in front of upper pit. Two ribs separate concentric ribs ventrally. Upper one joins inner concentric rib anteriorly. Lower one bifurcates but branches join again posteriorly. A long rib lies within inner concentric rib and parallels its lower part. A shorter one extends backward from lower pit and posteriorly these are joined by several smaller ribs which enclose 3 or 4 rhomboidal depressions.

Hinge straight, slightly impressed, almost as long as valve, details uncertain. External pits evident internally.

Holotype.—S.L.U. No. 1010; length: 1.02 mm.; height: 0.64 mm.; thickness: 0.63 mm.

Paratype.—S.L.U. No. 1011.

Seven specimens show considerable variability and more than one species may be represented. The more conspicuous variations are as follows:

An additional straight rib extends posteriorly from the upper pit.

Two long ribs, instead of one, are enclosed within the inner concentric rib.

The lower rib between the ventral parts of the concentric ribs does not bifurcate.

Genus GLYPTOPLEURINA Coryell 1928
GLYPTOPLEURINA EMBRYONICIA
Brayer, n. sp.
Plate 27, figures 9 a–b

In side view oblong subtrapezoidal; dorsal and ventral margins straight, almost parallel; anterior end well rounded ventrally, gently curved dorsally; posterior end truncated ventrally, slightly curved dorsally; both forming obtuse angles with dorsum. Maximum height slightly posterior to antero-cardinal angle. In dorsal view subcuneate; anterior end subacute, posterior blunt. Maximum thickness slightly above the middle and below postero-cardinal angle.

A pit lies before and slightly above center. A very deep furrow beginning at pit widens upward to dorsal margin. A vertically elongated node just anterior to furrow does not quite reach the dorsal margin. A large but less distinct lobe occupies postero-dorsal quarter of the shell. A ridge originating on anterior flank of posterior lobe curves, first upward and backward, then downward and roughly parallels margin of valve. Anteriorly, it rises, curves slightly backward and gradually dies out at base of anterior slope of anterior node. Two very shallow sulci originate on antero-ventral and postero-ventral sides of pit. One bounds anterior node ventrally and continues upward between the node and ridge. The other bounds posterior node antero-ventrally and stops at ridge. Surface otherwise smooth.

Hinge straight, not impressed, very high. In left valve a groove originates at antero-

cardinal angle, extends to middle of hinge but is uncertain posteriorly. Internal form of valve corresponds to external.

Holotype.—S.L.U. No. 1012; length: 0.94 mm.; height: 0.55 mm.; thickness: 0.55 mm.

Paratypes.—S.L.U. No. 1013.

Three left valves have been collected.

Family HOLLINELLIDAE Swartz, 1936
Genus HOLLINELLA Coryell, 1928
HOLLINELLA SWANIA Brayer, n. sp.
Plate 28, figures 13 a–b

In side view oblong subrhomboidal; dorsal margin straight; ventral margin broadly curved; anterior end broadly curved ventrally, slightly curved dorsally, forming obtuse angle with dorsum; posterior end slightly curved dorsally, truncated ventrally; maximum height a little anterior to middle of hinge. In dorsal view cuneate; posterior end subacute; anterior blunt. Nodes, frills and spines stand in strong relief. Frills originate ventrally, extend to cardinal angle, do not contact each other and are separated by an anterior notch. Maximum thickness (posterior spine excluded) on ventral summit of anterior lobe.

A broad median sulcus between anterior and posterior lobes occupies about the middle third of dorsal margin, narrows ventrally and turns slightly backward. It forks below and defines a low longitudinally directed ventral lobe which seems to unite the two lobes above. Posterior lobe large, hemispherical close to hinge line. Median lobe small, transversely elongated, joined to anterior lobe antero-ventrally from which it is separated by a small, very shallow sulcus connecting with the antero-dorsal part of median sulcus. Anterior node seems to bear a very shallow ill-defined sulcus extending backward at an angle of about 45° with hinge line, upper part lowest and smallest. Frill originates a little below middle of upper half of anterior end of shell, forward part almost straight, parallel with margin. In anterior part, frill has semicircular cross-section, posteriorly becomes flat and forms angle of about 45° with surface of valve, narrows and terminates posteriorly in a sharp spine. A series of small spines marks posterior margin but does not continue to hinge line. Entire external surface covered with minute papillae. No cardinal spines on right valve.

Hinge straight, not impressed, about five-sixths as long as shell. Right valve with delicate groove beginning at antero-cardinal angle, becoming less apparent posteriorly but probably extending to postero-cardinal angle. A small indistinct socket possibly present at anterior end. A minute rim present inside border of free edge fits into inner margin of left valve. Internal form of shell similar to external.

Holotype.—S.L.U. No. 1014; length: 1.76 mm.; height: 1.16 mm.; thickness: 0.82 mm.

Ten specimens have been collected. They are very fragile (four were broken during cleaning) and poorly preserved. Probably they represent more than one species delineated by differences in anterior margin of the frill, differences in shape, curvature and termination of the frill and differences in the length-height ratio. The holotype is the best preserved specimen.

Family GRAPHIADACTYLLIDAE
Kellett, 1936
Genus GRAPHIADACTYLLIS Roth, 1929
GRAPHIADACTYLLIS AXEA Brayer, n. sp.
Plate 27, figures 10 a–d

In side view oblong rhomboidal; dorsal margin straight (in some paratypes deflected by posterior shoulder); cardinal angles, especially the anterior, projecting in left valve; ventral margin straight to slightly concave; posterior end gently curved dorsally, truncated ventrally; anterior end broadly curved ventrally, gently curved dorsally forming obtuse angle with dorsum. Maximum height at antero-cardinal angle. In dorsal view elongate elliptical; both ends blunt, especially the posterior. Maximum thickness central (in some paratypes at the postero-dorsal shoulder).

Center marked by very faint pit, not apparent in some paratypes. Broad, very shallow sulci originating at pit enlarge and extend to anterior three-fifths of dorsal margin and complete length of ventral margin. A shoulder is present in some paratypes at the postero-dorsal angle. A frill marks entire free edge of valve, very narrow posteriorly, widens at middle of ventral margin, or in some paratypes farther forward, forms a

spine, or in some paratypes a sharp extremity, at middle of anterior end, becomes very narrow above. Surface with irregularly sized and distributed fine spines. Some specimens with a few rows of spines parallel to ventral margin and curving upward anteriorly to terminate close to anterior spine. Two other larger backward pointing spines always present postero-ventrally.

Valves unequal, left overlaps right. Hinge straight, impressed. Left valve slightly enlarged at cardinal extremities with sockets, free edge in vertical plane of hinge. A slightly impressed inner margin parallels free edge, close to cardinal extremities. Margin changes into ridge which bounds the sockets ventrally and disappears below hinge. Right valve with free edge rising above hinge, extends into left valve, not in plane of hinge. This bears a large, blunt tooth at each extremity, anterior one the larger. Teeth also united laterally by an inner margin depressed below the hinge.

A large subcircular pit of apparently variable nature present near center of interior.

Holotype.—S.L.U. No. 1015; length: 0.92 mm.; height: 0.49 mm.; thickness: 0.38 mm.

Paratypes.—S.L.U. No. 1016.

Twenty specimens in the collection show considerable variation in ornamentation and other characters. Perhaps more than one species is represented.

Family KIRKBYIDAE Ulrich and Bassler, 1906

Genus SAVAGELLA Geis, 1932

SAVAGELLA LINDAHLI (Ulrich), 1891

Plate 28, figures 12 a–b

Kirkbya lindahli ULRICH, 1891, Jour. Cincinnati Soc. Nat. Hist., vol. 13, p. 207, pl. 18, figs. 6 a–c.

Savagella lindahli GEIS, 1932, Jour. Paleontology, vol. 6, p. 169, pl. 22, figs. 8 a–b, pl. 24, figs. 7 a–e.

Nine specimens have been collected.

Genus EDITIA Brayer, n. gen.

In side view oblong rhomboidal; dorsal and ventral margins straight, generally parallel; posterior end truncated ventrally; anterior end obtusely angled dorsally. In dorsal view lanceolate; maximum thickness postero-dorsal.

A very small, rounded node is present close to antero-cardinal angle. A marginal ridge follows border of valve. One anterior and two posterior ridges are vertically directed in dorsal half of shell. Surface coarsely and irregularly reticulated.

Valve subequal, the right slightly larger. Hingement and internal characters uncertain.

Genotype.—*Editia elegantis* Brayer, n. sp.

This genus is closely related to both *Amphissites* and *Kirkbya*. It differs from them by its elongated rhomboidal outline, size, location of node, and pattern of ridges.

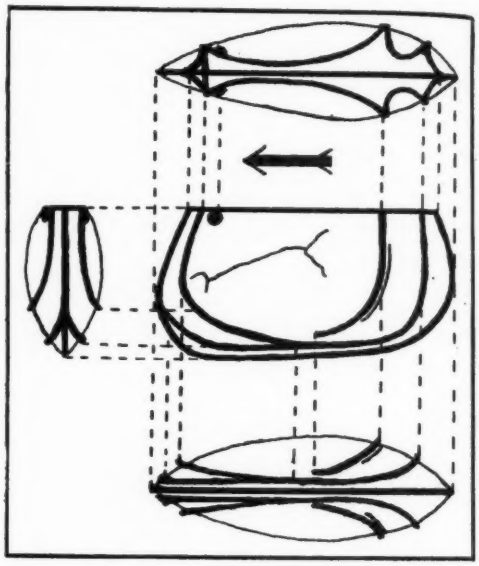


FIG. 4—Diagram of *Editia elegantis*.

EDITIA ELEGANTIS Brayer, n. sp.

Plate 28, figures 9 a–b

In side view oblong rhomboidal; dorsal and ventral margins straight, generally parallel; anterior end rounded ventrally, straight dorsally forming obtuse angle with dorsum; posterior end gently curved dorsally, truncated ventrally. In dorsal view lanceolate; both ends subacute, anterior sharper. Ridges and nodes well elevated. Maximum thickness on median ridge slightly below dorsum.

A rounded node, possibly an eye spot, present close to antero-cardinal angle. A ridge follows the entire border of valve.

Three other ridges are arranged as shown in text figure 4. A large sulcus underlies node, extends downward and backward inside anterior ridge. A second sulcus separated dorsally from first by a weak variable ridge consisting of local enlargement of reticulations. In some specimens, another ridge parallels median ridge posteriorly. Entire surface coarsely and irregularly reticulated.

Valves slightly unequal, manifested only by ridges of left valve being closer to margin. Hinge slightly below level of ridges, straight, almost as long as valve, details uncertain.

Holotype.—S.L.U. No. 1017; length: 0.59 mm.; height: 0.34 mm.; thickness: 0.29 mm.

Paratypes.—S.L.U. No. 1018.

Five specimens have been collected, four are complete and one is a left valve so poorly preserved that the hingement and internal characters could not be determined.

Genus BRILLIUS Brayer, n. gen.

In side view subrhomboidal; dorsal and ventral margins straight, generally parallel; posterior end truncated ventrally; anterior obtusely angled dorsally. In dorsal view subcuneate; posterior end abruptly constricted. Maximum thickness postero-ventral.

A pit lies antero-dorsal to center. A large furrow parallels posterior margin. A small furrow parallels anterior margin. Surface reticulated.

Hinge straight, not impressed. Right valve overlaps left along free edge.

Genotype.—Brillius distortus Brayer, n. sp.

This genus is similar to *Oliganisus* Geis but differs from it by: stronger overlap of valve; size, location and pattern of sulci; reticulated surface. It differs from *Kirkbya* and *Amphissites* by: absence of ridge; pattern of sulci.

Named in honor of Dr. Kenneth G. Brill, Jr., of Saint Louis University.

BRILLIUS DISTORTUS Brayer, n. sp.
Plate 28, figures 10 a–b

In side view oblong rhomboidal; both margins straight; anterior end well rounded ventrally, straight dorsally, forming obtuse angle with dorsum; posterior end gently curved dorsally, truncated ventrally. Maximum height about midway between antero-cardinal angle and middle of hinge. In dorsal view subcuneate, asymmetrical because of inequality of valves; anterior end subacute; posterior abruptly constricted, blunt. Maximum thickness close to center of postero-ventral quarter of valve; compressed toward antero-cardinal angle.

A subcircular pit lies antero-dorsal to center of valve at lower end of a broad shallow sulcus. A broad deep furrow originates anterior to postero-cardinal angle, curves posteriorly, enlarges and parallels entire posterior margin, disappears before reaching middle of ventral margin. A small lobe follows posterior margin, bounds sulcus posteriorly. A smaller furrow parallels major one antero-dorsally. Another small furrow originates at antero-cardinal extremity, parallels anterior margin, is bounded anteriorly by a small lobe which closely follows margin. Entire surface covered with irregularly shaped and distributed pits.

Valves unequal, right strongly overlaps left along entire free margin but left slightly overlaps right along hinge. Hinge straight, almost as long as shell, not impressed.

Holotype.—S.L.U. No. 1019; length: 0.90 mm.; height: 0.51 mm.; thickness: 0.39 mm.

Paratype.—S.L.U. No. 1020.

Only three complete specimens have been collected and hingement and internal characters have not been observed.

BRILLIUS YVEUS Brayer, n. sp.
Plate 28, figures 11 a–b

This species is closely related to *B. distortus* but differs as follows:

Dorsal and ventral margins straight, parallel.

Less cuneate in dorsal view, not appreciably compressed toward antero-cardinal angle, less abruptly constricted posteriorly, sides flatter.

Furrows narrower, less well developed.

Reticulations coarser, somewhat less distinct.

Left valve not overlapping right along hinge.

Holotype.—S.L.U. No. 1021; length: 1.04 mm.; height: 0.49 mm.; thickness: 0.31 mm.

Paratypes.—S.L.U. No. 1022.

Four specimens have been collected.

Genus ROUNDYELLA Bradfield, 1935
ROUNDYELLA SIMPLICISSIMA (Knight), 1928
Plate 28, figures 8 a–b

Amphissites simplicissimus KNIGHT, 1928, Jour. Paleontology, vol. 2, p. 266, pl. 32, figs. 11a–d, pl. 34, fig. 6 (Labette shale, Mo.). HARLTON, 1929, Texas Univ. Bull. 2901, p. 151, pl. 1, figs. 13a–c (Canyon group, Texas). DELO, 1930, Jour. Paleontology, vol. 4, p. 158, pl. 12, figs. 8a–b (Penn., Texas). WARTHIN, 1930, Oklahoma Geol. Survey, Bull. 53, p. 67, pl. 5, figs. 1a–b (Wetumka to Holdenville formations, Oklahoma). CORYELL and BILLINGS, 1932, Am. Midland Naturalist, vol. 13, p. 184, pl. 18, fig. 10 (Wayland shale, Texas) KELLETT, 1933, Jour. Paleontology, vol. 7, p. 97, pl. 15, fig. 8 (Elmdale formation, Kansas). UPSON, 1933, Nebraska Geol. Survey, Bull. 8, p. 41, pl. 3, fig. 6 (Garrison shale, Nebraska).

Roundyella simplicissima BRADFIELD, 1935, Bull. Am. Paleontology, vol. 22, p. 66. JOHNSON, 1936, Nebraska Geol. Survey, paper 11, p. 32, pl. 3, figs. 7–8 (Stanton formation, Nebraska). COOPER, 1946, Ill. Geol. Survey, Bull., no. 70, p. 108, pl. 17, figs. 29–36.

Not *Amphissites simplicissimus* CORYELL and MALKIN, Am. Museum Novitates, no. 891, p. 4, fig. 11.

Six specimens of this species have been collected in St. Louis County.

Genus KIRKBYA Jones, 1869
KIRKBYA WELLERI Geis, 1932

Kirkbya welleri GEIS, 1932, Jour. Paleontology, vol. 6, p. 161, pl. 23, fig. 8.

Numerous fragments of this species have been collected but no complete valve has been found. Careful comparison with Geis' holotype indicates that they are conspecific.

Geis described the structure of the inner keel as follows: "The proximal margin of the inner keel is pierced through by a row of small vertically elongated holes," but the holotype does not show this structure completely. Fragments collected by the writer show that the proximal margin of this keel is pierced by a row of holes elongated in the plane of the keel. When the distal part is broken away, the remaining part resembles a series of elongated parallel spines. The same structure characterizes the marginal keel, but Geis did not mention this, and, in the holotype, this keel is obscured by matrix.

KIRKBYA PENICHEA Brayer, n. sp.
Plate 28, figures 7 a–b

In side view semiovate; dorsal margin straight, very slightly deflected posteriorly by a shoulder; ventral margin straight, almost parallel to dorsum; anterior end broadly rounded ventrally, straight dorsally; posterior end truncated ventrally, straight dorsally; both almost at right angle to dorsum. Maximum height at posterior shoulder. In dorsal view ovate; both ends blunt, posterior most so. Maximum thickness slightly posterior to middle.

A marginal keel parallels free edge. An inner keel parallels the first, joins it at cardinal angles. Posteriorly a furrow lies inside inner keel, ventrally a large flat surface lies above it bearing a small longitudinally elongated elliptical pit a little in front of and below center of valve. A shoulder rises abruptly from the posterior furrow in dorsal half of valve, becomes gradually lower anteriorly. No appreciable furrow inside anterior part of inner keel. Keels seem to be perforated by minute holes proximally. Surface including furrow between keels finely reticulated, pits subcircular without special pattern.

Hinge straight, impressed, as long as valve. Right valve seems to overlap left slightly. Articulation features uncertain.

Holotype.—S.L.U. No. 1023; length: 0.90 mm.; height: 0.45 mm.; thickness: 0.49 mm.

This species is related to *K. welleri* but it is smaller, more inflated, its keels are less prominent and less obviously perforated proximally and it has a pit not present in *K. welleri*. Two specimens have been collected.

Several other species of *Kirkbya* occur in the Salem of Missouri but specimens in the writer's collection are not sufficiently numerous or well enough preserved to warrant their description.

Genus AMPHISSITES Girty, 1910
AMPHISSITES NODOSULCATUS Geis, 1932
Plate 28, figures 1 a-b

Amphissites nodosulcatus GEIS, 1932, Jour. Paleontology, vol. 6, p. 167, pl. 24 figs. 6a–c.

Four specimens of this species have been collected.

AMPHISSITES? MIMICUS Geis, 1932
Plate 28, figures 2 a-b

Amphissites mimicus GEIS, 1932, Jour. Paleontology, no. 2, p. 164, pl. 23, figs. 12a–c.

Two complete specimens and several fragments of this species have been collected. The holotype has not been available for comparison but Geis compared this species to *A. vanniae* (described in the same article p. 163) which it resembles closely and whose holotype has been seen.

Geis' description of *A. mimicus* is generally satisfactory for one of the St. Louis County specimens except for the statement: "..., but the inner ridge, which in *A. vanniae* separates from the false keel at the cardinal angles and invades the carapace well toward the center of the postero-inferior margin, is either absent altogether or is merely suggested by the arrangement of the reticulations." In this specimen, the ridge, although weak, is definitely present. The second specimen has an inner ridge like the first one but its outline is different; the hinge is much more impressed; in dorsal view the posterior end is blunter and the anterior more acute; and the thin low ridge, which encircles the furrow in *A. vanniae*, is present along the dorsal margin and on the posterior node. This ridge is not developed in *A. mimicus* Geis or in the first St. Louis County specimen.

AMPHISSITES VANNIAE var. MISSOURIENSIS
Brayer, n. var.
Plate 28, figures 3 a–b

This variety is similar to the typical form but it is smaller and less inflated and its ridges are stronger and higher.

Holotype.—S.L.U. No. 1024; length: 0.85 mm.; height: 0.49 mm.; thickness: 0.55 mm.

Paratypes.—S.L.U. No. 1025.

Three specimens of this variety have been collected.

AMPHISSITES ROTUNDUS var. MISSOURIENSIS Brayer, n. var.
Plate 28, figures 6 a–b

This variety is similar to the typical form but it is generally smaller and less inflated and its posterior and median nodes, although coalescent, are distinguishable.

Holotype.—S.L.U. No. 1026; length: 0.79 mm.; height: 0.51 mm.; thickness: 0.59 mm.

Paratypes.—S.L.U. No. 1027.

Eight specimens have been collected. In seven the two nodes are distinguishable.

AMPHISSITES ALTONODOSUS var. MISSOURIENSIS Brayer, n. var.
Plate 28, figures 4 a–b

This variety differs from the typical form by: its smaller size, stronger anterior and posterior nodes and a dorsally more elongated median node which is less inflated and does not project above the hinge.

Holotype.—S.L.U. No. 1028; length: 0.86 mm.; height: 0.48 mm.; thickness: 0.42 mm.

Only one left valve has been collected.

AMPHISSITES ARMATUS Brayer, n. sp.
Plate 28, figures 5 a–c

In side view elongated subrectangular; both margins straight, parallel; dorsal margin slightly deflected by anterior and posterior nodes; both ends strongly rounded ventrally, gently rounded dorsally, forming obtuse angles with dorsum. In dorsal view elongated; nodes and ridges conspicuous. Maximum thickness at median node.

A very minute pit occurs slightly anterior to center. A rounded median node surrounded by a sulcus lies antero-dorsally to pit. A weak ridge extends along dorsal margin, unites anteriorly with larger posterior node, both cuneate with acute ends ventral. A strong submarginal keel parallels border. A strong semielliptical inner keel arises from first below cardinal extremities and passes ventrally close to middle of ventral margin. Both keels pierced by minute proximal holes. Surface reticulated.

Hinge straight, impressed, almost as long as valve. Hingement uncertain. External nodes evident internally.

Holotype.—S.L.U. No. 1029; length: 0.95 mm.; height: 0.53 mm.; thickness: 0.37 mm.

Paratypes.—S.L.U. No. 1030.

Eight specimens have been collected. In some, the dorsal ridge is obsolete, and in others, the ventral part of the anterior node curves slightly posteriorly.

CONCLUSIONS

Only one species of *Paraparchites* has

been reported previously from the Salem limestone of Missouri. This genus is present in the writer's collection but the specimens have not been studied. Also, two more species, *Microcheilus distortus* Geis and *Cavellina glandella* (Whitfield), figured on plates are represented in the collection.

The fauna described here consists of species that may be divided into four groups as follows:

Group 1 includes *Savagella lindahli* which occurs in the Osage (Boone chert) of Oklahoma and Arkansas, the lower Meramec (Salem-Warsaw) of Illinois, and the lower Chester (Barnett) of Texas.

Group 2 includes most of the species belonging to *Glyptopleura*, *Amphissites* and *Kirkbya*. These are closely related to species described by Geis from Indiana but differ by their smaller size and certain minor characters. They indicate a close relationship between the Salem fauna of Indiana and Missouri but also seem to indicate slightly different environments.

Group 3 includes the species of *Glyptopleurina*, *Hollinella*, *Graphiadactyllis* and *Roundyella*. These genera have not been recorded previously from the Salem, but occur in the Mississippian or Pennsylvanian of Illinois.

Group 4 includes the species of the new genera *Editia* and *Brillius*. They are not known elsewhere.

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JOURNAL OF PALEONTOLOGY, VOL. 26, NO. 2, PP. 175–198, PLS. 29–38, 1 TEXT FIG., MARCH 1952

TRILOBITES OF THE FRANCONIA FORMATION, SOUTHEAST MINNESOTA

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ABSTRACT—Trilobites of the Upper Cambrian Franconia formation in southeast Minnesota are allocated to the *Elvinia* (12 genera and 13 species), *Conaspis* (7 genera and 9 species), *Ptychaspis-Prosaukia* (9 genera and 20 species), and *Dikelocephalus postrectus* (2 genera and 2 species) faunal zones. The *Ptychaspis* subzone is further subdivided into *Ptychaspis granulosa* and *P. striata* teilzones, and from the former a *Psalaspis* faunule is segregated. Eleven new species are described.

INTRODUCTION

DAVID DALE OWEN (1852) and James Hall (1863) were the first to describe trilobites from what is now called the Franconia formation. Since then only scattered illustrations and uninformative faunal lists had been published until Nelson (1951) described the trilobites of the St. Croix valley. This paper supports and augments Nelson's work by describing and illustrating trilobites from exposures of the Franconia formation that occur in southeast Minnesota along bluffs and tributaries of the Mississippi River. Species are described from the *Elvinia, Conaspis, Ptychaspis-Prosaukia* and *Dikelocephalus postrectus* zones of the standard Cambrian section (Howell et al., 1944).

The nucleus of this paper is embodied in dissertations by Feniak (1948) and Kurtz (1949) submitted to the Graduate School of the University of Minnesota and supervised by the senior author. Feniak described the faunas of the *Ptychaspis-Prosaukia* and *Dikelocephalus postrectus* zones, and Kurtz described those of the *Elvinia* and *Conaspis* zones. Subsequent field work by Bell and R. R. Berg, during the latter's regional study of the Franconia formation, have clarified stratigraphic and faunal relationships in southeast Minnesota. Plates 29–32 were constructed by Kurtz, Plates 33–38 by Feniak, and new taxonomic units are credited to them individually. However, the text of this paper was written in its entirety by Bell and he accepts sole responsibility for its format and for the taxonomic combinations here employed. Under conditions now prevailing it was impossible for the authors to collaborate closely. Final decisions were made arbitrarily by the senior author and possibly some of them are not concurred in by Feniak and Kurtz.

ACKNOWLEDGEMENTS

The field work for this study began in June of 1947, under the auspices of the Minnesota Geological Survey, and the authors are grateful to Dr. George M. Schwartz, Director, for his continued support. Our acknowledgements are also due Robert R. Berg for stratigraphic and faunal information; Christina Lochman Balk, E. A. Frederickson, Gilbert O. Raasch and James L. Wilson for paleontologic suggestions; Norman D. Newell of the American Museum of Natural History for the loan of Hall's types; A. R. Palmer for his assistance in the field; and E. H. Finkelnburg of Winona for giving his father's collection of trilobites to the University of Minnesota Department of Geology. Minnesota Geological Survey paid for reproduction of six plates.

LITHOLOGIC SUCCESSION

The Franconia formation in southeast Minnesota consists of four lithologically distinguishable members (Bell and Berg, 1950). Names given to them here are informal descriptive field terms, for the members are to be named and their regional relationships discussed by Berg. The members are described briefly below in stratigraphic order.

"Brownsand" member.—Sandstone, coarse and poorly sorted at base, medium-grained and better sorted upward, upper part

weathers brown and has glauconite concentrated on cross-laminations, 35–45 feet thick.

"Lower greensand" member.—sandstone, green, fine-grained and highly glauconitic, dolomite and dolomitized conglomerate sporadically in upper part, 15–20 feet thick.

"Micaceous sand" member.—sandstone, buff to pinkish, fine-grained and micaceous, slightly to non-glauconitic, considerable interbedded shale, 10–20 feet thick.

"Upper greensand" member.—sandstone, gray to green, fine-grained and slightly to highly glauconitic, predominantly massive beds containing worm borings but with many cross-laminated highly glauconitic beds, dolomitized conglomerate at top, 105–115 feet thick.

These lithic members do not coincide with the faunal units defined by Twenhofel, Raasch, and Thwaites (1935) and used by Stauffer, Schwartz, and Thiel (1939), who recognized the Ironton (*Camaraspis* zone), Goodenough-Taylors Falls (*Conaspis* zone), Hudson (*Ptychaspis-Prosaukia* zone) and Bad Axe (*Dikelocephalus postrectus* zone) "members." We contend that members of a formation should be recognizable lithic units, and that the definition of members on a faunal basis is unacceptable.

The boundary between the *Elvinia* and *Conaspis* zones falls within the top of the "lower greensand" member north of Minneiska but is near the middle of the member south of Reno. The boundary between the *Conaspis* and *Ptychaspis-Prosaukia* zones falls within the lower part of the "micaceous sand" member north of Minneiska but is in the lower part of the "upper greensand" member south of La Crescent. The base of the *Dikelocephalus postrectus* zone, which is known only south of Winona, falls 20–30 feet below the top of the "upper greensand" member.

FAUNAL SUCCESSION

This paper does not constitute an evaluation of the Franconian stage except insofar as it describes the trilobite faunas of the Franconia formation in its type region. Consequently, we accept for the present the zonal arrangement of the Cambrian Correlation Chart (Howell et al., 1944) although we suspect that when overlying faunas are described in proper stratigraphic perspective a more natural choice for the top of the Franconian stage will be either the base of the *Prosaukia* subzone or of the *Dikelocephalus postrectus* zone. Berg (1951) has demonstrated stratigraphic "climb" of faunal lines across lithic boundaries eastward from the Mississippi into central Wisconsin, emphasizing again that faunal and lithic taxonomies must be divorced, and that a "Trempealeauan" fauna or faunas may possibly occur in the Franconia formation of southeast Minnesota.

All Franconian zonal subdivisions of the Correlation Chart have been recognized except the *Irvingella major* ("*Ptychopleurites*") and *Briscoia* zones. The former, if present, occurs in the loose sands of the "lower greensand" member, from which fossils are almost never collected; possibly the dolomite and dolomitized conglomerates south of Brownsville will reward further search. The *Briscoia* zone, if present, occurs in the soft "wormstones" of the "upper greensand" member, in which fossils are almost never preserved. Raasch (1939, p. 114 and personal communications) and Berg (1951) have subdivided the *Conaspis* zone, and the assemblage described here is the highest recognized by them. Again the explanation probably is that lower assemblages, if present, occur in the "lower greensand" member, where fossils are rarely collected. Berg has collected *Eoorthis* from dolomitic siltstone in the "lower greensand" member south of Brownsville, indicating the presence of the lowest subdivision of the *Conaspis* zone.

Table 1 indicates the distribution of species recognized in this paper. The *Elvinia* zone is characterized by genera and species that are restricted to it. Except for the ubiquitous *Pseudagnostus josepha*, *Conaspis* zone species are restricted to it but different species of *Stigmacephalus* and *Wilbernia* occur in higher zones. Again except for *Pseudagnostus josepha*, the *Ptychaspis-Prosaukia* zone is characterized by species that are restricted to it. We have recognized *Ptychaspis granulosa* and *P. striata* teilzone components of the *Ptychaspis* subzone, and further segregated a local *Psalaspis* faunule at the base of the *Ptychaspis granulosa* teilzone. Each of these subdivisions is

characterized by the appearance for the first time of several species, some of which continue into the overlying unit. The *Prosaukia* subzone inherits three species from below but is notable for the first appearance of two genera, *Chariocephalus* and *Prosaukia*; in other respects the assemblage might just as reasonably in this area be labeled the

TABLE I.—RANGES OF TRILOBITE SPECIES IN THE FRANCONIA FORMATION

Genera and Species	Elvinia Zone	Conaspis Zone	Ptychaspis Subzone: Ptychaspis granulosa: Psalaspis faunule	Ptychaspis Subzone: Ptychaspis granulosa: teilzone	Ptychaspis striata teilzone	Prosaukia Subzone	Dikelocephalus postrectus Zone
Illaenurus truncatus Feniak, n. sp.							×
Dikelocephalus freeburgensis Feniak, n. sp.							×
Ptychaspis miniscaensis (Owen)						×	
Prosaukia misa (Hall)						×	
Prosaukia ? ambigua Ulrich and Resser						×	
Idahoia hamulus (Owen)						×	
Ellipsocephaloides gracilis Feniak, n. sp.						×	
Chariocephalus whitfieldi Hall						×	
Ptychaspis tuberosa Feniak, n. sp.					×	?	
Stigmacephalus flexifrons Feniak, n. sp.					×		
Ptychaspis striata Whitfield					×		
Monocheilus micros (Walter)					×		
Idahoia wisconsensis (Owen)				×	×	×	
Wilbernia cf. W. pero (Walcott)				×	×		
Ellipsocephaloides curtus (Whitfield)				×			
Ptychaspis granulosa (Owen)			×	×			
Monocheilus anatinum (Hall)			×	×	×		
Wilbernia explanata (Whitfield)			×				
Idahoia (Psalaspis) patersoni (Hall)			×				
Idahoia (Psalaspis) marginatus Feniak, n. sp.			×				
Idahoia cf. I. hera (Walcott)			×				
Pseudagnostus josepha (Hall)		×	×	×	×	×	×
Wilbernia halli Resser		×					
Wilbernia expansa Frederickson		×					
Taenicephalus altus Nelson		×					
Stigmacephalus similis Kurtz, n. sp.		×					
Parabolinoides hedrus Kurtz, n. sp.		×					
Croixana bipunctata (Shumard)		×					
Conaspis tumidus Kurtz, n. sp.		×					
Conaspis parvafrons Kurtz, n. sp.		×					
Xenocheilos cf. X. minutum Wilson	×						
Kindbladia sp.	×						
Irvingella sp.	×						
Iddingsia similis (Walcott)	×						
Iddingsia missouriensis Resser	×						
Housia varro (Walcott)	×						
Elvinia roemeri (Shumard)	×						
Dokimocephalus sp.	×						
Deadwoodia duris (Walcott)	×						
Comanchia prior Kurtz, n. sp.	×						
Cliffia lataegenae Wilson	×						
Camaraspis convexa (Whitfield)	×						
Berkeia typica Resser	×						

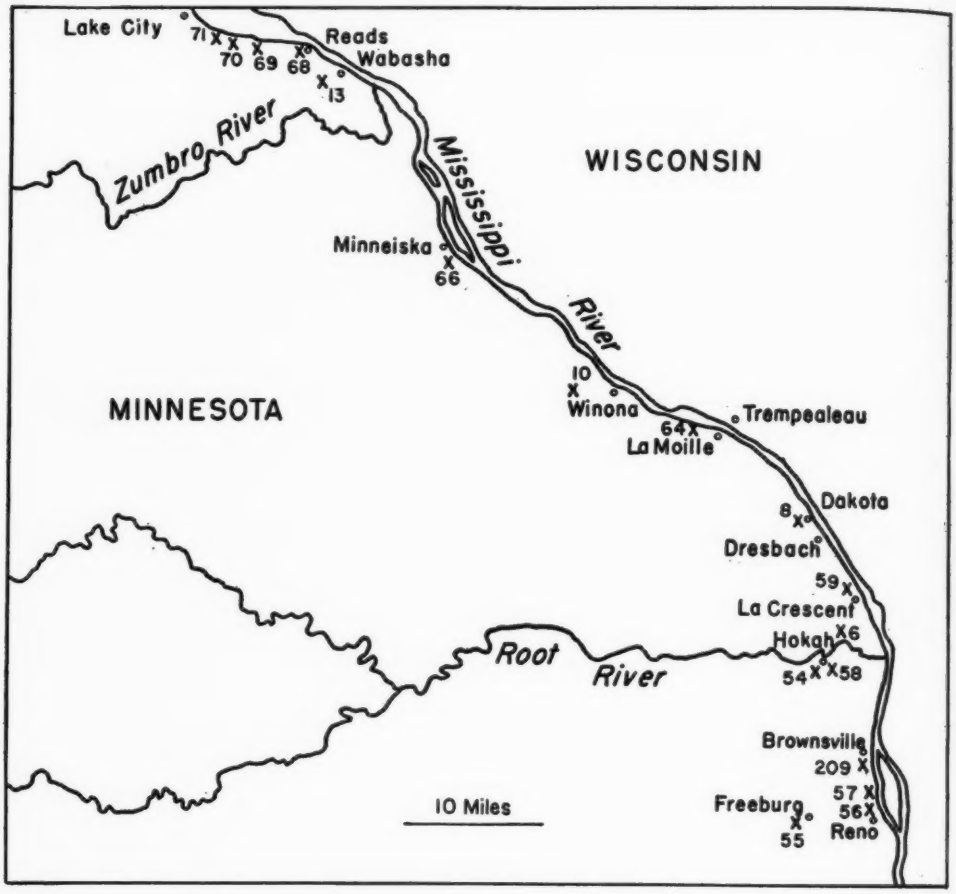


FIG. *1*—Franconia measured sections in southeast Minnesota.

Ptychaspis miniscaensis teilzone. However, this first appearance of saukid trilobites links the *Prosaukia* subzone to overlying Trempealeau faunas. Only two species, and possibly a third, have been recovered from the *Dikelocephalus postrectus* zone; they represent the first appearance of two genera that are abundantly present in overlying Trempealeau faunas.

LOCALITIES

Figure 1 shows the geographic distribu-

EXPLANATION OF PLATE 29

FIG. *1*—*Berkeia typica* Resser. Fragmentary cranidium, ×1, T6512a, Mount Tom. (p. 181)

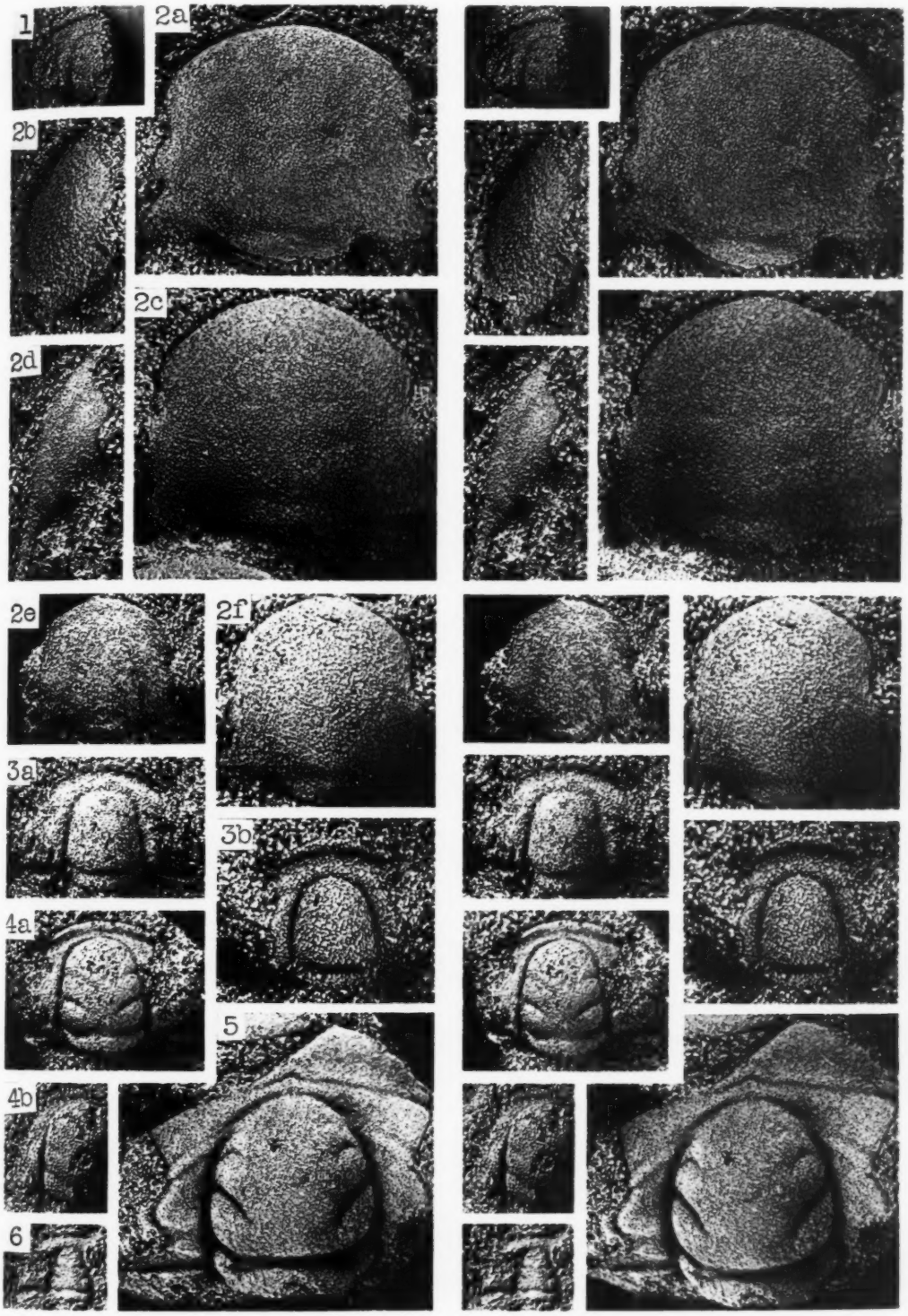
2a–f—*Camaraspis convexa* (Whitfield). *2a*, cranidium, ×2, T6526a, Mount Tom (F58.1K); *2b*, fragmentary free cheek, ×2, T6526b, Mount Tom (F58.1K); *2c*, topotype cranidium, ×2, T6525a, Ironton, Wis.; *2d*, free cheek, ×2, T6528a, 6 mi. east of Cashton, Wis.; *2e*, small flat cranidium, ×2, T6529a, La Moille (F64.1K); *2f*, strongly convex and elongate cranidium, ×2, T6527a, Goodenough Hill, Wis. (p. 181)

3a–b—*Deadwoodia duris* (Walcott). *3a*, typical cranidium, ×2, T6530a, Mount Tom (F58.1K); *3b*, cranidium with atypically conical glabella, ×2, T6531a, Millers Corner (F6.1K). (p. 183)

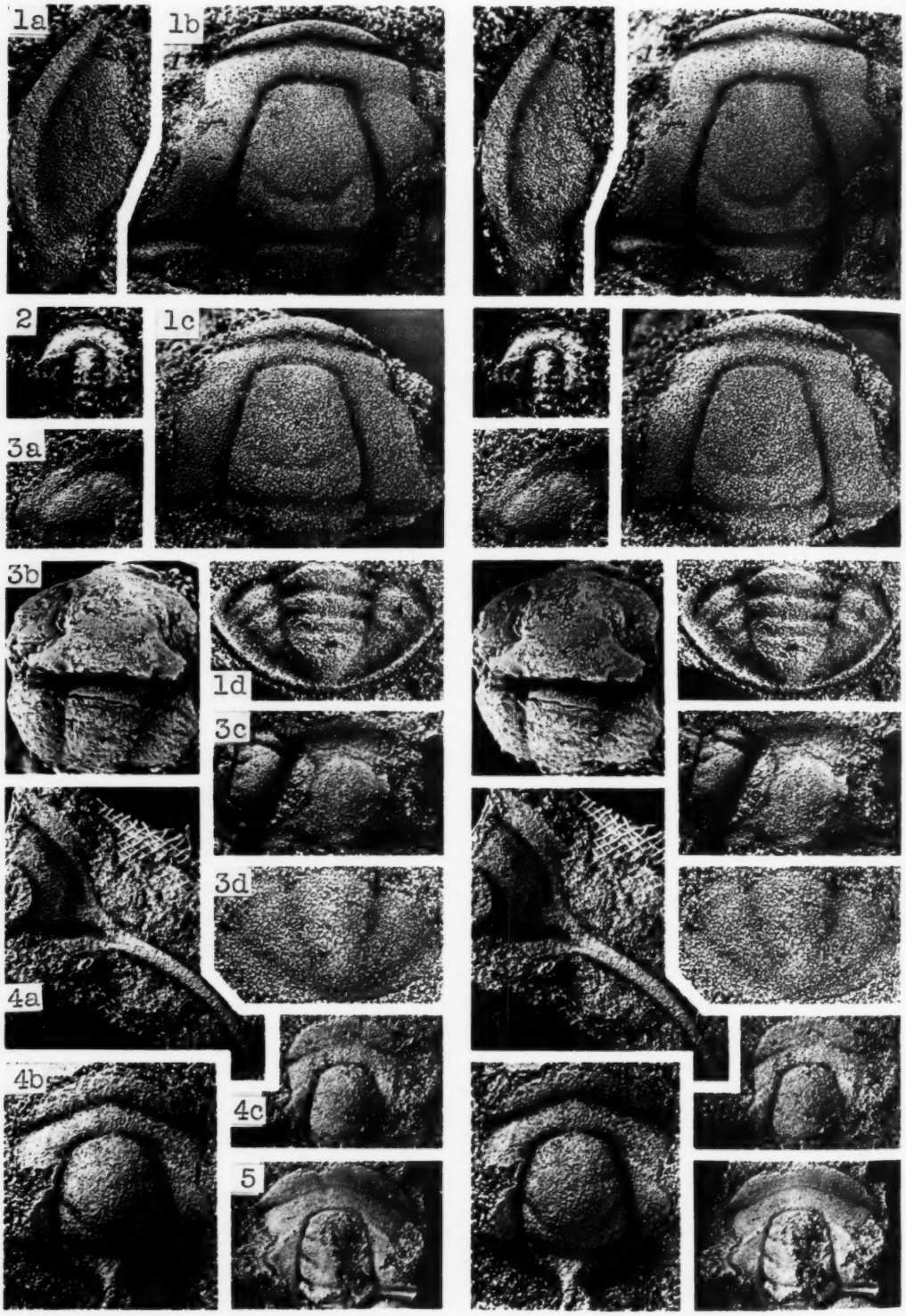
4a–b—*Comanchia prior* Kurtz, n. sp. *4a*, holotype cranidium, ×2, T6501a, Mount Tom (F58.1K) *4b*, fragmentary cranidium, ×2, T6509a, Millers Corner (F6.1K). (p. 182)

5—*Dokimocephalus* sp. Fragmentary cranidium, ×2, T6513a, Mount Tom (F58.1K). (p. 183)

6—*Cliffia lataegenae* Wilson. Fragmentary cranidium, ×3, T6524a, Reads (F68.1K). (p. 182)



Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota



Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota

tion of Minnesota localities where trilobites were collected from measured sections. Each locality is assigned a number, preceded by F in the text. Below, the localities are listed in alphabetical order, and individual collections are described as to content and stratigraphic position.

Brownsville (F209)—Road cuts on Minn. 26 at 2.7 and 3.3 mi. south of Brownsville. Measured and collected by R. R. Berg.

F209.1-.4B—"Micaceous sand" member, basal 10 feet; *Conaspis* zone.

Conaspis parvafrons	Taenicephalus altus
Conaspis tumidus	Wilbernia halli
Croixana bipunctata	

F209.5B—"Upper greensand" member, 15 feet above base; *Ptychaspis striata* teilzone.

Idahoia wisconsensis	Ptychaspis tuberosa
Ptychaspis striata	

Dakota (F8)—Bluff along road leading to upper cemetery on west edge of Dakota.

F8.1K—"Brownsand" member, top foot; *Elvinia* zone.

Camaraspis convexa	Housia varro
Deadwoodia duris	Iddingsia similis
Elvinia roemeri	Kindbladia sp.

F8.2K—"Micaceous sand" member, basal 4 feet; *Conaspis* zone.

Croixana bipunctata	Pseudagnostus josepha
Stigmacephalus similis	Taenicephalus altus
Parabolinoides hedrus	Wilbernia halli

Freeburg (F55)—Road cut on Minn. 249 at 1.5 mi. west of center of Freeburg.

F55.1F—"Upper greensand" member, about 15 feet below top; *Dikelocephalus postrectus* zone.

Dikelocephalus freeburgensis
Illaenurus truncatus

Hell Hollow (F57)—Ravine crossed by Minn. 26 at 1.5 miles north of Reno.

F57.1K—"Brownsand" member, top 4 feet; *Elvinia* zone.

Elvinia roemeri

F57.2K, F57.1B-.2B—"Micaceous sand" member, 9.5 feet exposed; *Conaspis* zone.

Conaspis parvafrons	Taenicephalus altus
Conaspis tumidus	Wilbernia expansa
Pseudagnostus josepha	Wilbernia halli

F57.2Bell—"Upper greensand" member, 19–20.5 feet above base; *Ptychaspis striata* teilzone.

Idahoia wisconsensis	Ptychaspis striata
Monocheilus anatinum	Ptychaspis tuberosa
Pseudagnostus josepha	Stigmacephalus flexifrons

F57.3B—"Upper greensand" member, 41–42.5 feet above base; *Prosaukia* subzone.

Chariocephalus whitfieldi
Prosaukia misa
Ptychaspis miniscaensis

F57.1F—"Upper greensand" member, 46–48.5 feet above base; *Prosaukia* subzone.

Idahoia hamulus	Pseudagnostus josepha
Prosaukia misa	Ptychaspis miniscaensis

F57.4B—"Upper greensand" member, 10–12 feet below top; *Dikelocephalus postrectus* zone.

Dikelocephalus freeburgensis
Illaenurus truncatus

Hokah (F54)—Quarry on north side of Minn. 44 at southwest edge of Hokah.

F54.2F—"Upper greensand" member, 22 feet above road level; *Prosaukia* subzone.

Idahoia wisconsensis	Pseudagnostus josepha
Prosaukia ? ambigua	Ptychaspis miniscaensis

La Crescent (F59)—Road cut on U.S. 61 at north edge of La Crescent.

F59.3K—"Brownsand" member, top foot; *Elvinia* zone.

Iddingsia similis

F59.5K—"Micaceous sand" member, basal foot. *Conaspis* zone.

Croixana bipunctata	Taenicephalus altus
Parabolinoides hedrus	Wilbernia expansa
Pseudagnostus josepha	Wilbernia halli
Stigmacephalus similis	

Explanation of Plate 30

FIGS. *1a–d—Elvinia roemeri* (Shumard). *1a*, free cheek, ×2, T6522a, Dakota (F8.1K); *1b–c*, large and medium cranidia, ×1.5, ×2, T6521a–b, Mount Tom (F58.1K); *1d*, pygidium, ×2, T6521c, Mount Tom (F58.1K). (p. 183)

2—Xenocheilos cf. *X. minutum* Wilson. Fragmentary cranidium, ×5, T6535a, Reads (F68.1K). (p. 185)

3a–d—Housia varro (Walcott). *3a*, free cheek, ×2, T6533b, Mount Tom (F58.1K); *3b*, incomplete carapace preserving free cheeks and six thoracic segments, ×3, T6534a, Dakota (F8.1K); *3c*, cranidium, ×2, T6533a, associated with small cranidium of *Iddingsia* sp., Mount Tom (F58.1K); *3d*, pygidium, ×2, T6533c, Mount Tom (F58.1K). (p. 183)

4a–c—Iddingsia similis (Walcott). *4a*, rubber cast of free cheek, ×1.3, T6515a, Dakota (F8.1K); *4b–c*, two fragmentary cranidia, the latter somewhat abraded, ×2, ×1, T6514a–b, Mount Tom (F58.1K). (p. 184)

5—Iddingsia missouriensis Resser. Fragmentary cranidium, ×1, T6532a, La Moille (F64.1K). (p. 184)

F59.6K—"Micaceous sand" member, 8–16 feet above base; *Conaspis* zone.

Conaspis tumidus	Wilbernia halli
Stigmacephalus similis	

Lake City (F71)—Small ravine and road cut on U.S. 61 at 4 mi. southeast of stone pier in Lake City.

F71.1Bell—"Micaceous sand" member, 6 feet above pavement at mouth of ravine, top few inches of member; *Ptychaspis granulosa* teilzone.

Ellipsocephaloides curtus	Monocheilus anatinum
Idahoia wisconsensis	Ptychaspis granulosa

F71.1F, .2Bell—"Upper greensand" member, 10 feet above base; *Ptychaspis striata* teilzone.

Idahoia wisconsensis	Ptychaspis tuberosa
Monocheilus anatinum	Stigmacephalus flexifrons
Pseudagnostus josepha	Wilbernia cf. W. pero
Ptychaspis striata	

F71.2F—"Upper greensand" member, 43 feet above base; *Prosaukia* subzone.

Chariocephalus whitfieldi
Prosaukia misa
Ptychaspis miniscaensis

La Moille (F64)—Road cut on U.S. 61 at 2.1 mi. north of center of La Moille.

F64.1K—"Brownsand" member, top foot; *Elvinia* zone.

Camaraspis convexa	Iddingsia missouriensis
Elvinia roemeri	Iddingsia similis

Maple Springs (F69)—Road cut on U.S. 61 at 4.3 mi. northwest of Reads and 0.2 mi. southeast of Maple Springs bridge.

F69.1F—"Micaceous sand" member, 3 feet above base of exposure, and 5 feet below top of member; *Ptychaspis granulosa* teilzone.

Idahoia wisconsensis	Ptychaspis granulosa
Monocheilus anatinum	Wilbernia cf. W. pero
Pseudagnostus josepha	

F69.2Bell—"Micaceous sand" member, top few inches; *Ptychaspis granulosa* teilzone.

Ellipsocephaloides curtus	Pseudagnostus josepha
Idahoia wisconsensis	Ptychaspis granulosa
Monocheilus anatinum	

F69.2F—"Upper greensand" member, about 10 feet above base; *Ptychaspis striata* teilzone.

Idahoia wisconsensis	Stigmacephalus flexifrons
Monocheilus anatinum	Wilbernia sp.
Ptychaspis striata	

F69.3F—"Upper greensand" member, 14.5–16 feet above base; *Ptychaspis striata* teilzone.

Ellipsocephaloides sp.	Ptychaspis striata
Idahoia wisconsensis	Ptychaspis tuberosa
Monocheilus anatinum	Wilbernia cf. W. pero

Millers Corner (F6)—Bluff near intersection of U.S. 16 and Minn. 26, 3.5 mi. northeast of Hokah.

F6.1K—"Brownsand" member, top foot; *Elvinia* zone.

Camaraspis convexa	Elvinia roemeri
Comanchia prior	Housia varro
Deadwoodia duris	Iddingsia missouriensis

Minneiska (F66)—Ravine crossed by U.S. 61 at 0.8 mi. south of center of Minneiska.

F66.1F, .1B, .2B—"Upper greensand" member, basal 7 feet of exposure; *Ptychaspis granulosa* teilzone.

Ellipsocephaloides curtus	Monocheilus anatinum
Idahoia wisconsensis	Pseudagnostus josepha
	Ptychaspis granulosa

F66.1Bell—"Upper greensand" member, about 24 feet above base of exposure; *Ptychaspis striata* teilzone.

Idahoia wisconsensis	Ptychaspis striata
Monocheilus anatinum	Stigmacephalus flexi-
Pseudagnostus josepha	frons

F66.2F—"Upper greensand" member, about 50 feet above base of exposure; *Prosaukia* subzone.

Chariocephalus whitfieldi	Prosaukia misa
Idahoia hamulus	Ptychaspis miniscaensis

Mount Tom (F58)—Southwest side of Mount Tom above creek and dam on east edge of Hokah.

F58.1K—"Brownsand" member, top foot; *Elvinia* zone

Berkeia typica	Elvinia roemeri
Camaraspis convexa	Housia varro
Comanchia prior	Iddingsia missouriensis
Deadwoodia duris	Iddingsia similis
Dokimocephalus sp.	

F58.2K—"Micaceous sand" member, lower 12 feet exposed; *Conaspis* zone.

Conaspis parvafrons	Stigmacephalus similis
Conaspis tumidus	Taenicephalus altus
Pseudagnostus josepha	Wilbernia halli

F58.1F—"Upper greensand" member, about 23 feet above base; *Ptychaspis striata* teilzone.

Idahoia wisconsensis	Ptychaspis striata

Reads (F68)—Ravine and road cut on U.S. 61 in Reads.

F68.1K—"Lower greensand" member, 5–8 feet below top; *Elvinia* zone.

Cliffia lataegenae
Camaraspis convexa
Elvinia roemeri
Irvingella sp.
Xenocheilos cf. X. minutum

F68.1F—"Micaceous sand" member, 6–10 feet above base; *Ptychaspis granulosa* teilzone, *Psalaspis* faunule.

Idahoia cf. I. hera
Idahoia (Psalaspis) marginatus
Idahoia (Psalaspis) patersoni
Monocheilus anatinum
Pseudagnostus josepha
Ptychaspis granulosa
Wilbernia explanata

F68.2F—"Upper greensand" member, about 25 feet above base; *Ptychaspis granulosa* teilzone.

Idahoia wisconsensis	Pseudagnostus josepha
Monocheilus anatinum	Ptychaspis granulosa

Reno (F56)—Large road cut on Minn. 26 opposite railroad station at Reno.

F56.1F—"Upper greensand" member, in road ditch at base of exposure; *Ptychaspis striata, P. tuberosa* and *Monocheilus anatinum* were identified in the field but specimens were not preserved.

Idahoia wisconsensis

F56.2F—"Upper greensand" member, 16 feet above base of exposure; *Prosaukia* subzone.

Prosaukia ? ambigua	Ptychaspis miniscaensis

F56.3F—"Upper greensand" member, 18 feet above base of exposure; *Prosaukia* subzone.

Chariocephalus whitfieldi
Idahoia hamulus
Ptychaspis miniscaensis

F56.4F—"Upper greensand" member, 29 feet above base of exposure; *Prosaukia* subzone.

Chariocephalus whitfieldi
Ellipsocephaloides gracilis
Pseudagnostus josepha
Ptychaspis miniscaensis

Rileys Coulee (F70)—Road cut on U.S. 61 and ravine at 4 mi. southeast of stone pier in Lake City.

F70.1F—"Upper greensand" member, 18 feet above road level; *Prosaukia* subzone.

Chariocephalus whitfieldi	Prosaukia misa
Idahoia hamulus	Ptychaspis miniscaensis
Idahoia wisconsensis	Ptychaspis tuberosa

Stockton Hill (F10)—Road cuts along U.S. 14 on east side of Stockton Hill, just beyond northwest outskirts of Winona.

F10.2F—"Upper greensand" member, about 55 feet below top; *Prosaukia* subzone.

Idahoia hamulus
Ptychaspis miniscaensis

F10.2X—"Upper greensand" member, position unknown; *Prosaukia* subzone. Collected by C. R. Stauffer.

Chariocephalus whitfieldi
Idahoia hamulus
Prosaukia misa

F10.3X—"Upper greensand" member, position unknown; *Dikelocephalus postrectus* zone. Collected by C. R. Stauffer.

Dikelocephalus freeburgensis

Wabasha (F13)—Road cuts along Minn. 60 at 1.5 mi. southwest of intersection with U.S. 61 in Wabasha.

F13.1F—"Upper greensand" member, about 20 feet above lowest exposed rock; *Prosaukia* subzone.

Chariocephalus whitfieldi
Idahoia hamulus
Ptychaspis miniscaensis

SYSTEMATIC DESCRIPTIONS

Descriptions are arranged alphabetically by genus and species within faunal zones. Localities from which trilobites were obtained are designated by an F-number, and individual collections are given a decimal number followed by the initial of the collector. Occurrences of species are recorded by localities listed alphabetically, and faunal associations are shown on Table 1. Kurtz collected and originally described (1949) the *Elvinia* and *Conaspis* zone faunas, and Feniak (1948) the *Ptychaspis-Prosaukia* and *Dikelocephalus postrectus* zone faunas.

Plates illustrating this paper are made up of stereo pairs and may be viewed by the unaided eye or a simple lens-type stereoscope. Figured specimens have a University of Minnesota Geological Museum catalogue number and are deposited in the Paleontological Collections.

ELVINIA ZONE

Genus BERKEIA Resser 1937

BERKEIA TYPICA Resser

Plate 29, figure 1

Agraulos convexus var. B. BERKEY, 1898, p. 288, pl. 20, figs. 5, 6.

Berkeia typica RESSER, 1937, p. 3; WILSON, 1951, p. 624, pl. 89, figs. 1, 2; NELSON, 1951, p. 774, pl. 107, fig. 15.

This species is very rare throughout the upper Mississippi valley; only one imperfect specimen is known from southeast Minnesota.

Occurrence.—Elvinia zone at Mount Tom (F58, collected by Eunice Peterson).

Genus CAMARASPIS Ulrich and Resser in Ulrich 1924

CAMARASPIS CONVEXA (Whitfield)

Plate 29, figures 2a–f

Arionellus (*Agraulos*) *convexus* WHITFIELD, 1878, p. 57.

Camaraspis convexa (Whitfield) FREDERICKSON, 1948, p. 798 (for synonymy to date), pl. 123, figs. 12, 13; WILSON, 1949, p. 33, pl. 10, figs. 6, 8, 11; WILSON, 1951, p. 630, pl. 90, figs. 1–8; NELSON, 1951, p. 774, pl. 107, fig. 18.

Camaraspis is by far the most abundant genus in the *Elvinia* zone of Minnesota; its remains constitute a coquina in the upper few feet of the "Brownsand" member from Dakota south to the Iowa line, but collecting them from the friable sandstone is difficult or impossible.

Frederickson (1948, p. 799) described *C. plana* from Oklahoma and some workers, notably Raasch (personal communication), have identified it in the upper Mississippi Valley and believe that it occurs stratigraphically above *C. convexa*. Our experience does not support either contention. Specimens (Pl. 29, fig. 2e) distinctly less convex than typical *C. convexa* do occur,

but for several reasons their identification as *C. plana* seems unnecessary, if not erroneous: they are almost invariably much smaller than typical *C. convexa*, and the smaller the specimen the less its convexity; they occur either as the only representative of *Camaraspis*, or associated with large *C. convexa*—never with convex specimens of comparable size; they hold no consistent position relative to *C. convexa* within the *Elvinia* zone; and the bifurcating occipital furrow described and figured by Frederickson has not been identified.

Occurrence.—*Elvinia* zone at Dakota (F8.1K), La Moille (F64.1K), Millers Corner (F6.1K), Mount Tom (F58.1K), Reads (F68.1K).

Genus CLIFFIA Wilson 1951
CLIFFIA LATAEGENAE (Wilson)
Plate 29, figure 6

Acrocephalites lataegenae WILSON, 1949, p. 31, pl. 10, fig. 14.
Cliffia lataegenae (Wilson) WILSON, 1951, p. 633, pl. 90, figs. 18–24.

Several specimens, poorly preserved in dolomitic greensand at a single locality, conform to this species.

Occurrence.—*Elvinia* zone at Reads (F68.1K)

Genus COMANCHIA Frederickson 1950
COMANCHIA PRIOR Kurtz, n. sp.
Plate 29, figures 4a–b

Cranidium, excluding posterior limbs, quadrangular in outline, strongly convex longitudinally and transversely, anterior margin broadly rounded. Glabella quadrate, slightly tapered and bluntly rounded anteriorly, strongly convex, length about three-fourths the length of cranidium, width slightly less than three-fourths length of glabella; dorsal furrow deep laterally, shallow anteriorly. Glabellar furrows moderately impressed, anterior pair faint or absent, second pair short and bent backward, posterior pair bent backward and may be joined across the glabella by a shallow transverse furrow. Occipital furrow broad. Occipital ring nearly as wide as frontal area. Frontal area about one-sixth length of cranidium. Brim and border subequal in width, both convex; brim almost vertical, border horizontal. Fixed cheeks about one-third width of glabella, horizontal. Palpebral lobes elongate, posterior to midline of glabella. Palpebral furrows gently convex outward, complete. Posterior limbs narrow, strap-like, about as wide as occipital ring. Anterior course of facial suture slightly divergent in front of palpebral lobes; posterior course outward at nearly right angles to axial line.

Holotype.—Cranidium, T6501a, length 10 mm.

Remarks.—This species differs from *C. amplooculata* (Frederickson), the type species, in having a nearly vertical brim, a brim and border subequal in width, and in being two to three times larger.

In defining *Comanchia*, Frederickson (1950, p. 901) listed four ways in which it differed generically from *Ptychopleurites* Kobayashi. Points 1 and 3 are largely inference; points 2 and 4 clearly describe the essential differences between *C. amplooculata* and the species here defined. Because *Ptychopleurites* is based on a single poorly

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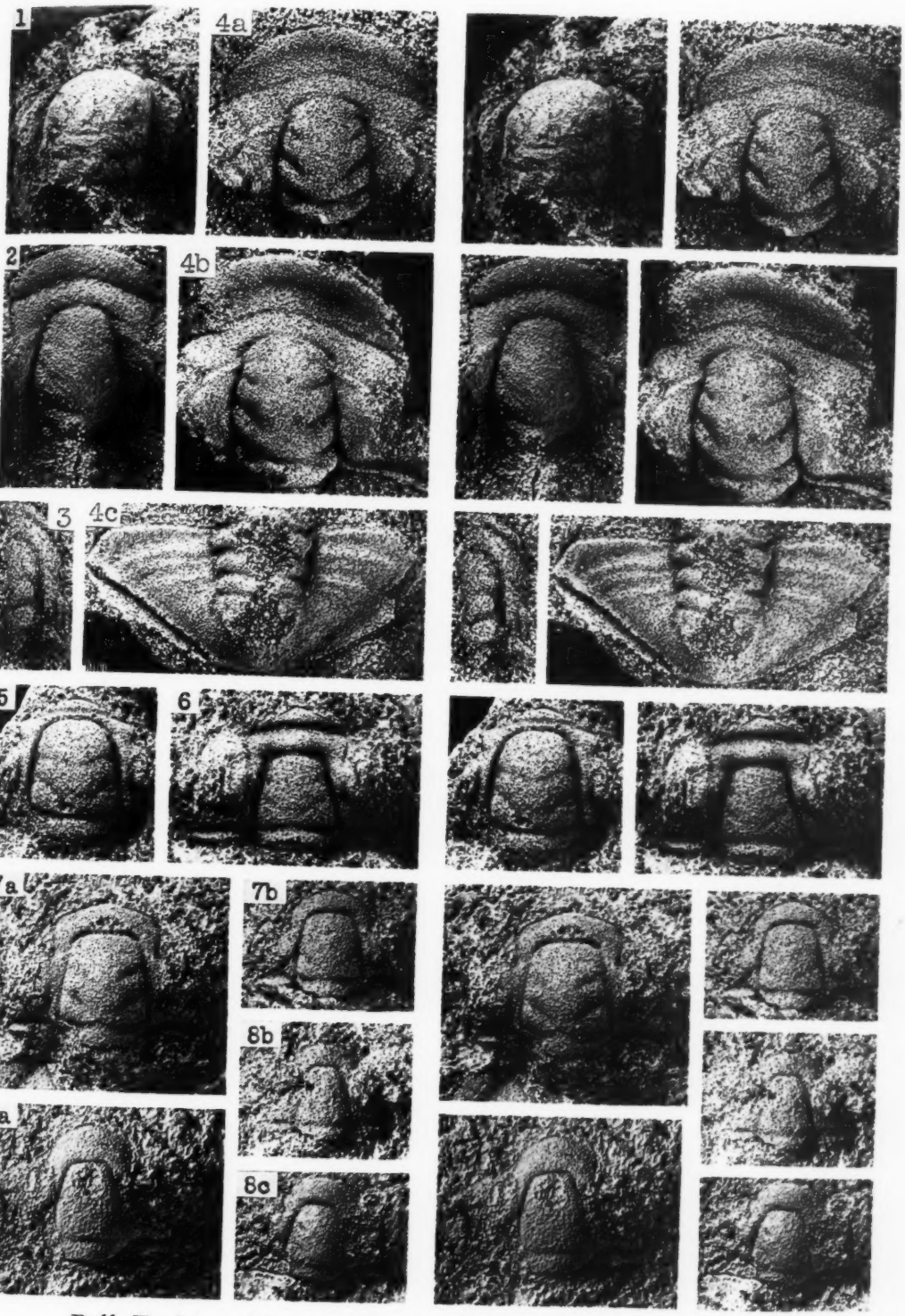
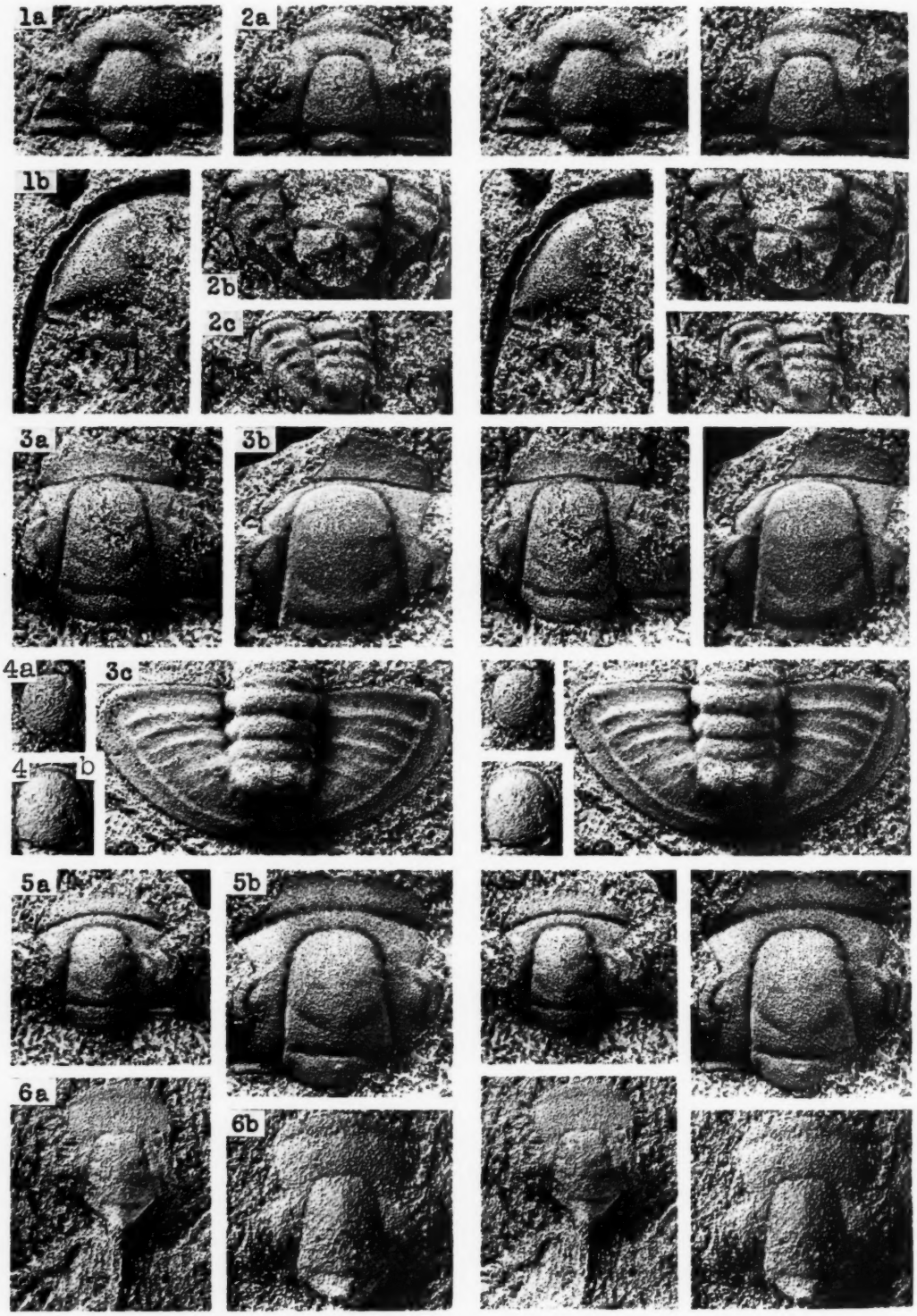
EXPLANATION OF PLATE 31

FIG. *1*—*Irvingella* sp. Distorted cranidium, ×3, T6520a, Reads (F68.1K). (p. 184)
2—*Iddingsia similis* (Walcott). Cranidium, ×2, T6516a, La Crescent (F59.3K). (p. 184)
3—*Kindbladia* sp. Fragmentary cranidium, ×2, T6511a, Dakota (F8.1K). (p. 184)
4a–c—*Iddingsia missouriensis* Resser. *4a–b*, medium and large cranidia, ×2, ×1.3, T6517a–b, Mount Tom (F58.1K); *4c*, large pygidium, ×1.5, T6517c, Mount Tom (F58.1K). (p. 184)
5—*Conaspis tumidus* Kurtz, n. sp. Holotype cranidium, complete except for posterior limbs, ×3, T6502a, Mount Tom (F58.2K). (p. 185)
6—*Taenicephalus altus* Nelson. Complete cranidium, ×3, T6503a, Dakota (F8.2K). (p. 187)
7a–b—*Conaspis parvafrons* Kurtz, n. sp. Holotype and paratype cranidia on same slab, ×3, T6508a–b, Cedar Falls, Wis., collected by Eunice Peterson. (p. 185)
8a–c—*Stigmacephalus similis* Kurtz, n. sp. *8a*, holotype cranidium, ×3, T6538a, La Crescent (F59.5K); *8b*, small cranidium showing position of palpebral lobe, ×3, T6539a, Dakota (F8.2K); *8c*, small cranidium, ×3, T6540a, Mount Tom (F58.2K). (p. 186)



Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota



Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota

illustrated specimen whose stratigraphic and faunal relationships are ambiguous, further debate is fruitless, but it seems pertinent to suggest that in this instance generic splitting has been extreme to say the least.

Occurrence.—*Elvinia* zone. Very rare at Millers Corner (F6.1K), Mount Tom (F58.1K); more abundant in Adams, Richland and Vernon Counties, Wisconsin.

Genus DEADWOODIA Resser 1938
DEADWOODIA DURIS (Walcott)
Plate 29, figures 3a–b

Asaphiscus? duris WALCOTT, 1916b, p. 392, pl. 63, figs. 8, 8a.
Dunderbergia? declivita MILLER, 1936, p. 30, pl. 8, figs. 37, 38.
Deadwoodia duris (Walcott) WILSON, 1948, p. 33, pl. 8, figs. 9–17; 1951, p. 633, pl. 92, figs. 1–5.

Specimens from Minnesota suggest that probably there is a complete gradation between *D. panope* (Walcott), the type species, and *D. duris*. The specimen of Pl. 29, fig. 3b has an atypically conical glabella and upsloping fixed cheeks; Wilson possibly would assign it to his genus *Dellea*.

Occurrence.—Moderately common in *Elvinia* zone at Dakota (F8.1K), Millers Corner (F6.1K), Mount Tom (F58.1K).

Genus DOKIMOCEPHALUS Walcott 1924
DOKIMOCEPHALUS sp.
Plate 29, figure 5

One incomplete specimen was found. It resembles *D. intermedia* (Resser) but the border is destroyed and specific affinities cannot be determined.

Occurrence.—*Elvinia* zone at Mount Tom (F58.1K).

Genus ELVINIA Walcott 1924
ELVINIA ROEMERI (Shumard)
Plate 30, figures 1a–d

Dikelocephalus roemeri SHUMARD, 1861, pp. 220, 221.
Elvinia roemeri (Shumard) BRIDGE, 1937, pp. 251, 255 (for synonymy to date), pl. 69, figs. 1–21; FREDERICKSON, 1949, p. 352 (for synonymy to date), pl. 69, figs. 19–21; WILSON, 1951, p. 642, pl. 92, figs. 18–22; NELSON, 1951, p. 775, pl. 107, fig. 8.

Bridge (1937) gave an exhaustive discussion of *Elvinia roemeri* and pointed out that variations having no geographic or stratigraphic significance had been called species. Frederickson (1949) placed in synonymy with *E. roemeri* ten species named by Resser (1937, 1938, 1942). *Elvinia roemeri*, displaying its usual variability, is one of the more abundant species in the *Elvinia* zone of Minnesota.

Occurrence.—Common in *Elvinia* zone at Dakota (F8.1K), Hell Hollow (F57.1K), La Moille (F64.1K), Millers Corner(F6.1K), Mount Tom (F58.1K), Reads (F68.1K).

Genus HOUSIA Walcott 1916
HOUSIA VARRO (Walcott)
Plate 30, figures 3a-d

Dolichometopus (*Housia*) *varro* WALCOTT, 1916b, p. 374, pl. 65, figs. 1, 1a–e.
Housia varro (Walcott) WALCOTT, 1924, p. 57, pl. 12, fig. 4; 1925, p. 95, pl. 18, figs. 4–8; SHIMER and SHROCK, p. 625, pl. 265, fig. 9.

This species, one of the more abundant elements of the *Elvinia* fauna, has never before been reported from the upper Mississippi valley. Although the glabellar furrows and occipital node described by Wal-

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EXPLANATION OF PLATE 32

FIGS. *1a–b*—*Croixana bipunctata* (Shumard). *1a*, cranidium with node on occipital ring, ×3, T6506a, Dakota (F8.2K); *1b*, free cheek, ×3, T6506b, Dakota (F8.2K). (p. 185)
2a–c—*Parabolinoides hedrus* Kurtz, n. sp. *2a*, holotype cranidium, ×3, T6505a, La Crescent (F59.5K); *2b–c*, paratype pygidia showing spinose border, ×3, T6505b–c, La Crescent (F59.5K). (p. 186)
3a–c—*Wilbernia expansa* Frederickson. *3a–b*, small and large cranidia, ×3, ×2, T6519a–b, La Crescent (F59.5K); *3c*, large pygidium, ×1.7, T6519c, La Crescent (F59.5K). (p. 187)
4a–b—*Pseudagnostus josepha* (Hall). Specimens thought to be abraded abdominal shields, oriented as if to illustrate "*Agnostus*" *parilis* Hall, ×4, T6541a–b, Reads (F68.1F). (p. 196)
5a–b—*Wilbernia halli* Resser. Small and large cranidia, the larger with node on occipital ring, ×2, T6518a–b, La Crescent (F59.5K). (p. 188)
6a–b—*Idahoia* cf. *I. hera* (Walcott). Fragmentary cranidia on same slab, ×1.5, ×3, T6661a–b, Reads (F68.1F). (p. 189)

cott are not visible on our specimens, all of which are preserved in the coarse sand of the "Brownsand" member, they conform otherwise to *Housia varro*, the type species. The specimen of Pl. 30, fig. 3b is enrolled and preserves the free cheeks and six of the thoracic segments.

Occurrence.—Common in *Elvinia* zone at Dakota (F8.1K), Millers Corner (F6.1K), Mount Tom (F58.1K).

Genus IDDINGSIA Walcott 1924

Iddingsia WALCOTT, 1924, p. 58; 1925, p. 97; SHIMER and SHROCK 1944, p. 627.
Plataspella WILSON, 1949, p. 41; 1951, p. 646.

The *Elvinia* zone in Minnesota contains two clearly distinguishable species that are here assigned to *Iddingsia*. Both generic and specific assignments present problems, for that group of trilobites variously designated *Burnetia*, *Dokimocephalus*, *Iddingsia*, and *Plataspella* is in a state of considerable confusion. Strangely enough, neither Resser (1942) who described nine new species of *Iddingsia*, nor Wilson (1949) who defined the new genus *Plataspella*, based on one of Resser's species, made any reference to *Iddingsia similis*, the type species.

No attempt can be made here to clarify the confusion except to express the opinion that the characters used by Wilson to separate *Plataspella* from *Iddingsia* are not generically significant, and to suggest that *Iddingsia*, like *Elvinia*, has suffered from excessive splitting.

Type species.—*Ptychoparia similis* Walcott 1884.

IDDINGSIA MISSOURIENSIS Resser

Plate 30, figure 5; plate 31, figures 4a–c

Iddingsia missouriensis RESSER, 1942, p. 86, pl. 16, figs. 21–25.
Iddingsia crassimarginata RESSER, 1942, p. 87, pl. 16, figs. 30–32.
Plataspella crassimarginata (Resser) WILSON, 1949, p. 41; 1951, p. 647.

The Minnesota specimens assigned to this species are notable for their large maximum size (length of cranidium up to 30 mm.) and their striking similarity to the specimen illustrated by Resser as *I. crassimarginata;* in all other respects they agree with Resser's description of *I. missouriensis*—even to the presence of an occipital node. Resser's two species are regarded here as conspecific; the name *I. missouriensis* is chosen because of page preference.

Occurrence.—*Elivina* zone. Rare at La Moille (F64.1K), Millers Corner (F6.1K); abundant at Mount Tom (F58.1K).

IDDINGSIA SIMILIS (Walcott)

Plate 30, figures 4a–c; plate 31, figure 2

Ptychoparia similis WALCOTT, 1884, p. 52, pl. 10, fig. 10.
Iddingsia similis (Walcott) WALCOTT, 1924, pl. 12, fig. 6; 1925, p. 97, pl. 16, figs. 8, 9; SHIMER and SHROCK, 1944, pl. 265, figs. 15–16.

Except for the presence of a prominent occipital spine, a character of unknown meaning, the Minnesota specimens do not seem to differ significantly from the illustrated type specimen of *I. similis;* the same conclusion applies to several species named by Resser (1942), notably *I. anatina.*

Apparently this species differs significantly from *I. missouriensis* only in having a smaller maximum size (length of cranidium up to 18 mm.), facial sutures distinctly less divergent anterior to the eyes, and a convex rather than a concave border.

Occurrence.—*Elvinia* zone. Rare at Dakota (F8.1K), La Crescent (F59.3K), La Moille (F64.1K); common at Mount Tom (F58.1K).

Genus IRVINGELLA Ulrich and Resser in Walcott 1924

IRVINGELLA sp.

Plate 31, figure 1

Only one poorly preserved and distorted cranidium is known; it occurs in dolomitic greensand.

Occurrence.—*Elvinia* zone. Reads (F68.1K).

Genus KINDBLADIA Frederickson 1948

KINDBLADIA sp.

Plate 31, figure 3

Only one incomplete cranidium is known. Morphologically *Kindbladia* is essentially a transversely compressed *Berkiea*, and whether it deserves more than subgeneric status is doubtful.

Occurrence.—*Elvinia* zone. Dakota (F8.1K).

Genus XENOCHEILOS Wilson 1949
XENOCHEILOS cf. X. MINUTUM Wilson
Plate 30, figure 2

A single cranidium, poorly preserved in dolomitic greensand, may belong to Wilson's species.

Occurrence.—*Elvinia* zone. Reads (F68.1K).

CONASPIS ZONE

Genus CONASPIS Hall 1863
CONASPIS PARVAFRONS Kurtz, n. sp.
Plate 31, figures 7a–b

Cranidium, excluding posterior limbs, quadrangular in outline, moderately convex transversely and longitudinally. Glabella moderately convex, rectangular, truncate anteriorly, with anterior pits. Glabellar furrows moderately impressed, anterior pair absent, second and posterior pairs short and pit-like, not connecting across the glabella. Frontal area convex, smooth, length between one-fourth and one-fifth that of cranidium. Fixed cheeks horizontal, width less than one-fourth that of glabella. Palpebral lobes long, situated on mid-line of glabella. Palpebral furrows faint, complete when visible and gently curved. Posterior limbs narrow. Facial sutures strongly divergent anterior to eyes.

Holotype.—Cranidium, T6508a, length 7.5 mm.; paratype, cranidium, T6508b.

Remarks.—The generic assignment is based on the presence of complete palpebral furrows, short frontal area, and narrow posterior limbs. This species is distinguished from *C. tumidus* by the smooth frontal area, and from *Croixana bipunctata* by its narrow posterior limbs and longer palpebral lobes.

Only three specimens are present in our collections from southeast Minnesota, but R. R. Berg has collected this species from near Brownsville, Minnesota, and at three localities in Wisconsin. The type specimens were collected several years ago at Cedar Falls, Wis., by Eunice Peterson.

Occurrence.—Rare in the *Conaspis* zone at Brownsville (F209.3B), Hell Hollow (F57.2K), Mount Tom (F58.2K).

CONASPIS TUMIDUS Kurtz, n. sp.
Plate 31, figure 5

Conocephalites perseus HALL (part), 1863, p. 153, pl. 7, figs. 18, 19, 23.

Conaspis perseus SHIMER & SHROCK, 1944, pl. 263, fig. 27; NELSON, 1951, p. 775, pl. 107, fig. 11.

Cranidium, excluding posterior limbs, quadrangular in outline, strongly convex transversely and longitudinally, bluntly pointed anteriorly. Glabella strongly convex, rectangular, broadly rounded anteriorly, length two-thirds and width about three-fifths that of cranidium, anterior pits faint or absent. Glabellar furrows moderately impressed, anterior pair absent, second and posterior pairs bent backward and may be joined across glabella by faint transverse furrows. Frontal area steeply downsloping, about one-sixth length of cranidium, divided into subequal brim and border by deep marginal furrow. Fixed cheeks upsloping, width less than one-fourth that of glabella. Palpebral lobes short, situated on mid-line of glabella. Palpebral furrows deep, complete, straight. Posterior limbs narrow, about equal in width to frontal area. Facial sutures slightly divergent anterior to eyes, slightly curved posterior to eyes.

Holotype.—Cranidium, T6502a, length 7 mm., collected by C. R. Stauffer.

Remarks.—This species is readily distinguished from *C. perseus*, the type species, by its strongly convex glabella, short and steeply downsloping frontal area, and narrow posterior limbs. *Conaspis tumidus* has been collected by Nelson at Franconia, Minnesota, by Berg near Brownsville and Reno, Minnesota, and it is characteristic of the *Conaspis* zone along the Mississippi and St. Croix rivers; *C. perseus*, limited to a lower part of the *Conaspis* zone, has not been found closer than 25 miles east of the rivers in Wisconsin.

Occurrence.—Moderately common in *Conaspis* zone at Brownsville (F209.1B), Hell Hollow (F57.1B), La Crescent (F59.6K), Mount Tom (F58.2K).

Genus CROIXANA Nelson 1951
CROIXANA BIPUNCTATA (Shumard)
Plate 32, figures 1a–b

Arionellus bipunctatus SHUMARD, 1862, p. 101; HALL, 1863, p. 169, pl. 7, figs. 50, 51.
Conaspis bipunctatus (Shumard) WALCOTT, 1914, p. 358.
Stigmacephalus bipunctatus (Shumard) RESSER, 1937, p. 26.
Croixana bipunctata (Shumard) NELSON, 1951, p. 775, pl. 107, figs. 10, 12.

This species is sporadically very abundant on some bedding surfaces. Its subconical glabella, deep anterior pits, bulbous frontal area without marginal furrow, small palpebral lobes anterior to midline of glabella, and short broadly triangular posterior limbs distinguish it from *Conaspis parvafrons*.

Occurrence.—Common to abundant in *Conaspis* zone at Brownsville (F209.3B), Dakota (F8.2K), La Crescent (F59.5K).

Genus PARABOLINOIDES Frederickson 1949

PARABOLINOIDES HEDRUS Kurtz, n. sp.

Plate 32, figures 2a–c

Cranidium, excluding posterior limbs, quadrangular in outline, moderately convex longitudinally and transversely, anterior margin rounded to obtusely pointed. Glabella very slightly elongate, tapering, truncate anteriorly, length and width both about six-tenths that of cranidium. Glabellar furrows very faint to absent. Occipital furrow deep, curved forward distally. Occipital ring widest at center, probably with a faint node. Frontal area one-third or slightly more length of cranidium, marginal furrow deep, curved. Brim convex, downsloping, slightly wider than border. Border convex, nearly horizontal. Fixed cheeks upsloping, width less than one-third that of glabella. Palpebral lobes short, situated on anterior one-third line of glabella. Palpebral furrows faint, straight. Ocular ridge not visible. Posterior limbs wide, length slightly less than occipital ring. Posterior furrow broad, shallow. Anterior course of facial suture divergent in front of palpebral lobes, posterior course curving outward and then back around posterior limbs.

Pygidium semicircular in outline. Axis consists of four segments, strongly convex transversely, bluntly rounded posteriorly; width one-third or greater than pygidium; length equal to that of pygidium minus border. Border narrow, bears four pairs of spines that become progressively shorter toward the axis.

Types.—Holotype, cranidium, T6505a, length 7.5 mm.; paratypes, pygidia, T6505b–c.

Remarks.—This species is distinguished from *Taenicephalus altus* with which it is associated, by its wider posterior limbs, downsloping brim, and horizontal lunate rather than triangular border.

This species may well be congeneric with *Maustonia nasuta* (Hall), but until the legal and taxonomic confusion surrounding *Maustonia* Raasch 1939 and *Parabolinoides* is cleared away by a thorough study of the several conaspid genera, an assignment to *Parabolinoides* seems best.

Occurrence.—Rare in the *Conaspis* zone at Dakota (F8.2K), La Crescent (F59.5K).

Genus STIGMACEPHALUS Resser 1937

STIGMACEPHALUS SIMILIS Kurtz, n. sp.

Plate 31, figures 8a–c.

Cranidium, excluding posterior limbs, elongate quadrangular in outline, moderately convex longitudinally and transversely, anterior margin strongly rounded. Glabella elongate, tapering, truncate anteriorly, length slightly more than half and width slightly less than half length of cranidium. Glabellar furrows very faint, usually absent. Occipital furrow shallow, straight. Occipital ring wide, widest at

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EXPLANATION OF PLATE 33

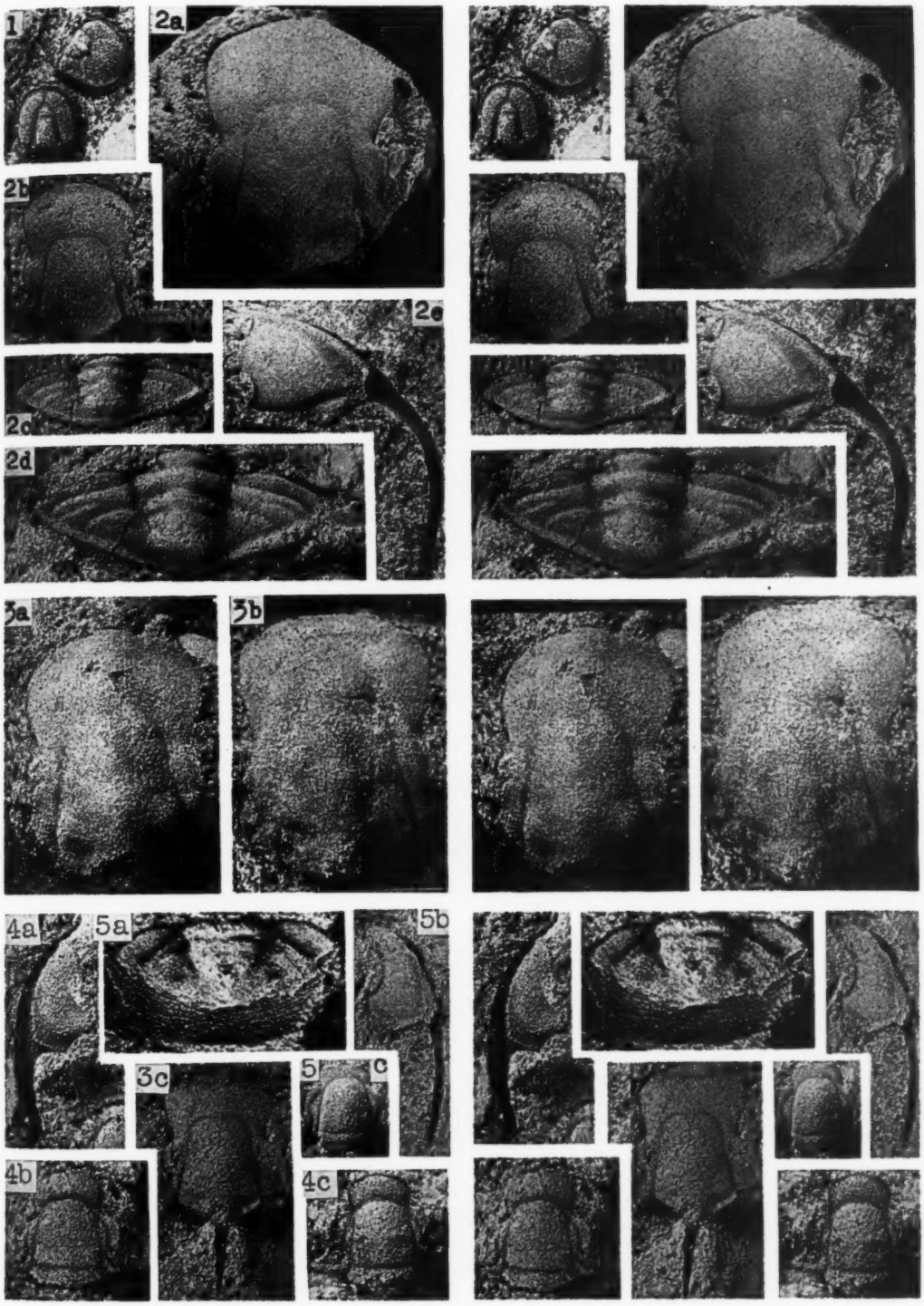
FIG. *1*—*Pseudagnostus josepha* (Hall). Topotype head and abdominal shields, ×3, T6620a–b, Trempealeau, Wis., collected by C. R. Stauffer. (p. 196)

2a–e—*Idahoia* (*Psalaspis*) *patersoni* (Hall). *2a–b*, large and small cranidia, ×1.5, ×2, T6621a–b, Reads (F68.1F); *2c–d*, small and large pygidia, ×2, T6621c–d, Reads (F68.1F); *2e*, large free cheek, ×2, T6621e, Reads (F68.1F), collected by W. A. Finkelnburg. (p. 191)

3a–c—*Idahoia* (*Psalaspis*) *marginatus* Feniak, n. sp. *3a–b*, large cranidia, the latter the holotype, ×2, T6622a–b, Reads (F68.1F); *3c*, small cranidium that, except for longitudinal convexity, is identical with *I.* cf. *I. hera* of Pl. 32, figs. *6a–b*, ×2, T6622c, Reads (F68.1F), collected by W. A. Finkelnburg. (p. 190)

4a–c—*Monocheilus micros* (Walter). *4a*, free-cheek, ×3, T6624a; *4b–c*, cranidia, ×3, T6624b–c. collected by C. R. Stauffer at Trempealeau, Wis. (p. 191)

5a–c—*Monocheilus anatinum* (Hall). *5a*, topotype pygidium mentioned but not illustrated by Hall (1863, p. 159), ×3, Am. Mus. Nat. Hist. No. 329/1, 3 miles above Reads; *5b*, free cheek, ×2, T6623b, Reads (F68.1F); *5c*, small cranidium, ×2, T6623c, Reads (F68.1F). (p. 191)



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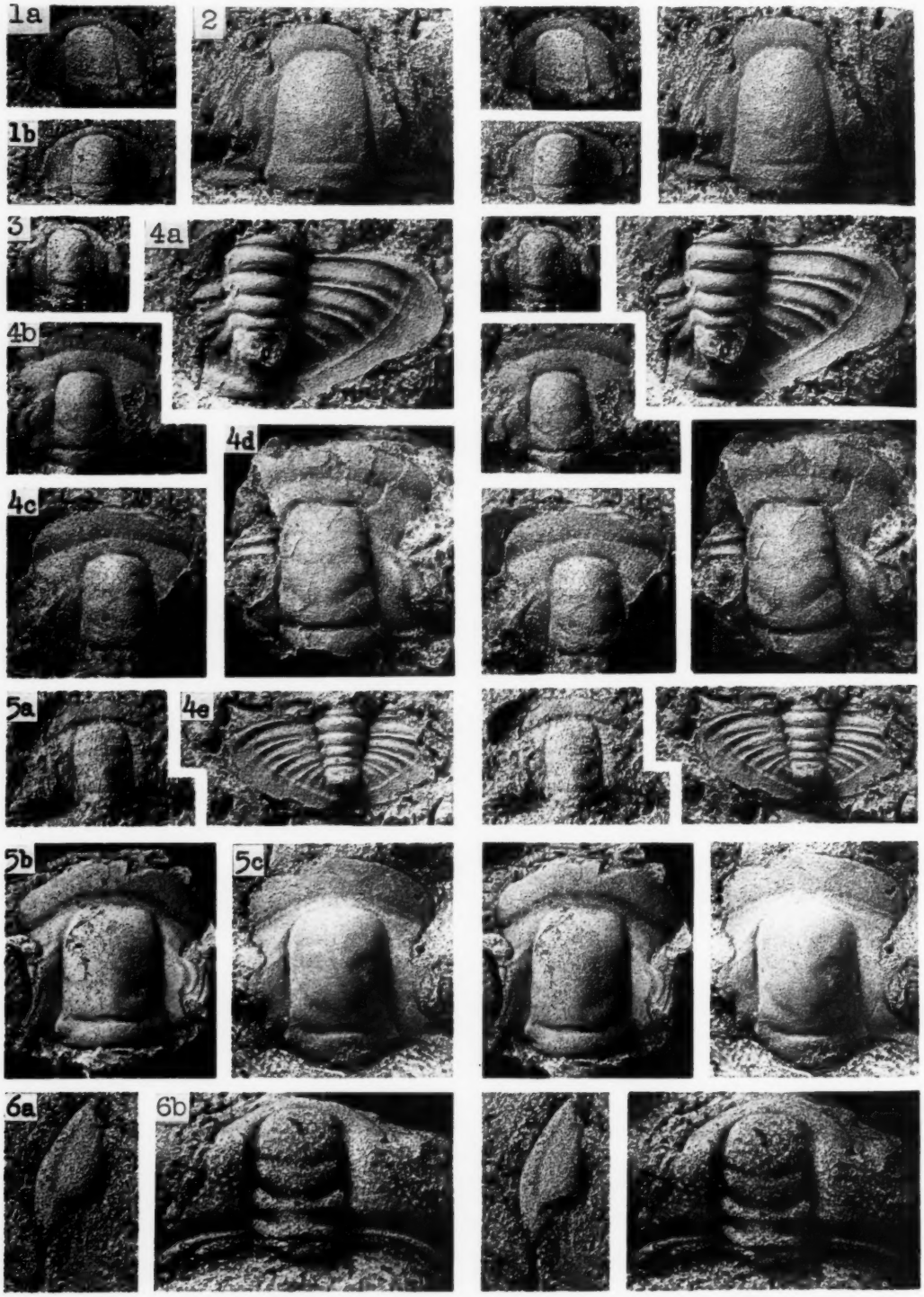


Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota

center. Frontal area slightly down-sloping, one-fourth or slightly more length of cranidium, marginal furrow shallow, straight. Brim and border both slightly convex, equal in width. Fixed cheeks horizontal, width less than one-third that of glabella. Palpebral lobes short, situated about on anterior one-third line of glabella. Palpebral furrows and ocular ridges unknown. Posterior limbs wide, subtriangular, length distinctly less than occipital ring. Posterior furrow broad, deep. Anterior course of facial suture strongly divergent in front of palpebral lobes, then curves sharply toward axial line. Posterior course curving outward and then back around posterior limbs.

Holotype.—Cranidium, T6538a, length 6.5 mm.

Remarks.—This species, the first *Stigmacephalus* to be reported from the *Conaspis* zone, differs from *S. oweni* s. s. in having a tapering and truncate glabella, a marginal furrow and consequent subequal brim and border, and in having smaller palpebral lobes situated somewhat farther forward. Some specimens of Nelson's (1951, p. 780) *S. oweni* var. A are quite like *S. similis* except in size and position of palpebral lobes, and in lacking a marginal furrow.

The assignment of this species to *Stigmacephalus* is tentative, though close morphologic similarity is apparent. However, the forward position of the eyes is characteristic of the *Kendallia-Maustonia-Parabolinoides* complex, and perhaps when those genera are better understood this species may be assigned differently.

Occurrence.—Moderately common in *Conaspis* zone at Dakota (F8.2K), La Crescent (F59.5K, .6K), Mount Tom (F58.2K). Berg has collected it from the upper part of the *Conaspis* zone in Trempealeau and Jackson counties, Wisconsin.

Genus TAENICEPHALUS Ulrich and Resser in Walcott 1924

TAENICEPHALUS ALTUS Nelson

Plate 31, figure 6

Taenicephalus shumardi (Hall) WALCOTT, 1925, pl. 17, figs. 15–17; SHIMER & SHROCK, 1944, pl. 266, fig. 17.

Taenicephalus altus NELSON, 1951, p. 777, pl. 107, figs. 2, 4, 7.

This species differs from *T. shumardi* (Hall), which occupies a position lower in the *Conaspis* zone throughout western Wisconsin, chiefly in the wider brim. The associated fauna is the same as that described by Nelson (1951) from the St. Croix valley.

Occurrence.—Common in the *Conaspis* zone at Brownsville (F209.1B, .3B), Dakota (F8.2K), Hell Hollow (F57.2K), La Crescent (F59.5K), Mount Tom (F58.2K).

Genus WILBERNIA Walcott 1924

WILBERNIA EXPANSA Frederickson

Plate 32, figures 3a–c

Wilbernia expansa FREDERICKSON, 1949, p. 362, pl. 72, figs. 13–16.

This species is clearly defined by its concave border and narrow, nearly straight marginal furrow almost tangent with front of glabella.

Occurrence.—Rare in *Conaspis* zone at Hell Hollow (F57.2K), La Crescent (F59.5K).

EXPLANATION OF PLATE 34

FIGS. *1a–b—Ellipsocephaloides curtus* (Whitfield). Cranidia, ×2, T6625a–b, Goodenough Hill, Wis. (p. 188)

2—Monocheilus anatinum (Hall). Large cranidium, ×2, T6623a, Reads (F68.1F), collected by W. A. Finkelnburg. (p. 191)

3—Ellipsocephaloides gracilis Feniak, n. sp. Holotype cranidium, ×3, T6626a, Reno (F56.4F). (p. 188)

4a–e—Wilbernia explanata (Whitfield). *4a, e*, large and small pygidia, ×1.5, T6627a, e, Reads (F68.1F); *4b–d*, cranidia, ×1.5, T6627b–d, Reads (F68.1F). (p. 195)

5a–c—Wilbernia cf. *W. pero* (Walcott). *5a*, small cranidium, ×2, T6629a, Maple Springs (F69.1F); *5b*, large cranidium with row of tubercles in marginal furrow, ×1, T6630a, Trempealeau, Wis., collected by C. R. Stauffer; *5c*, large cranidium, ×1, T6628a, Lake City (F71.1F). (p. 195)

6a–b—Ptychaspis granulosa (Owen). *6a*, small free cheek, ×2, T6633b, Reads (F68.2F); *6b*, large cranidium, ×1.5, T6631a, Durand, Wis., collected by C. R. Stauffer. (p. 193)

WILBERNIA HALLI Resser
Plate 32, figures 5a–b

Conocephalites diadematus HALL, 1863 (part), pl. 7, figs. 37, 38.
Wilbernia halli RESSER, 1937, p. 28; NELSON, 1951, p. 777, pl. 107, figs. 17, 19.

This species is defined by its tapering glabella, a brim-border ratio of between 1:1 and 1:2, and a border curvature ranging from slightly convex to slightly concave. The variability of this species is characteristic of the genus, which ranges throughout the *Conaspis* and *Ptychaspis-Prosaukia* zones in the upper Mississippi valley, and is badly in need of detailed study.

Occurrence.—Common in *Conaspis* zone at Brownsville (F209.2B, .3B, .4B), Dakota (F8.2K), Hell Hollow (F57.2K), La Crescent (F59.5K, .6K), Mount Tom (F58.2K).

PTYCHASPIS-PROSAUKIA ZONE
Genus CHARIOCEPHALUS Hall 1863
CHARIOCEPHALUS WHITFIELDI Hall
Plate 37, figures 4a–e

Chariocephalus whitfieldi HALL, 1863, p. 175, pl. 6, figs. 49–53; pl. 10, fig. 20; SHIMER & SHROCK, 1944, pl. 264, figs. 11–13.

Supplementary description of pygidium—Outline transversely ovate, posterior margin evenly rounded. Axis broad anteriorly, tapering rapidly and becoming less distinct posteriorly, consists of three segments. Pleural lobes narrow, convex; interpleural grooves broad and shallow. Border narrow, concave or flat.

Remarks.—This is the type species of *Chariocephalus*. It was not referred to by Resser (1942, pp. 4–13), but it differs distinctly from all fourteen new species described by him in that the palpebral lobes are much shorter and strongly arcuate. It is restricted to the *Prosaukia* subzone in Minnesota and Wisconsin.

Occurrence.—Common in *Prosaukia* subzone at Hell Hollow (F57.1F), Lake City (F71.2F), Minneiska (F66.2F), Reno (F56.3F, .3B), Rileys Coulee (F70.1F), Wabasha (F13.1F).

Genus ELLIPSOCEPHALOIDES
Kobayashi 1935
ELLIPSOCEPHALOIDES CURTUS (Whitfield)
Plate 34, figures 1a–b

Ellipsocephalus curtus WHITFIELD, 1878, p. 58; 1882, p. 191, pl. 1, fig. 18.
Ellipsocephaloides curtus (Whitfield) KOBAYASHI, 1935, p. 196.

Whitfield's original description is adequate, except that the glabella is prominent and elevated well above the fixed cheeks. This species differs from any subsequently described in having fixed cheeks that are very nearly as wide as the glabella.

Occurrence.—Rare in *Ptychaspis granulosa* teilzone at Lake City (F71.1 Bell), Maple Springs (F69.2Bell), Minneiska (F66.1B, 1F).

ELLIPSOCEPHALOIDES GRACILIS
Feniak, n. sp.
Plate 34, figure 3

Cranidium transversely quadrangular in outline, moderately convex longitudinally and transversely, anterior margin truncate. Glabella slightly elongate, parallel sided, strongly rounded anteriorly, length slightly less than three-fourths and width slightly less than half that of cranidium. Glabellar furrows faint or absent except posterior one, which is continuous across glabella. Occipital furrow shallow, straight. Occipital ring wide, parallel sided. Frontal area strongly downsloping, convex, about one-tenth length of cranidium, marginal furrow absent. Fixed cheeks slightly downsloping, width less than two-thirds that of glabella. Palpebral lobes long, broad, arcuate, elevated above free cheeks. Posterior limbs narrow, short, rarely preserved.

Holotype.—Cranidium, T6626a, length 3.5 mm.

Remarks.—This species differs from *E. curtus* in its proportionally narrower glabella and distinctly narrower fixed cheeks, those of *E. curtus* being more than three-fourths width of the glabella. *E. gracilis* probably is conspecific with several if not most of the eleven species described by Resser (1942, pp. 62–67), but until they are restudied realistically no assignment can be made to any one of them. Although only one specimen has so far been found in Minnesota, R. R. Berg has collected the species from the *Prosaukia* subzone in Adams and Dunn counties, Wisconsin.

Occurrence.—Rare in *Prosaukia* subzone at Reno (F56.4F).

Genus IDAHOIA Walcott 1924

IDAHOIA HAMULUS (Owen)

Plate 36, figures 2a–c; plate 37, figure 2

Lonchocephalus hamulus OWEN, 1852, p. 576, Tab. 1A, figs. 8, 12.

Idahoia hamulus (Owen) RESSER, 1935, p. 35 (for synonymy to date); SHIMER & SHROCK, pl. 265, figs. 18, 19.

This species is distinguished by a low ridge in the marginal furrow and by only slight divergence of the facial sutures anterior to the palpebral lobes, producing an effect of elongation of the cranidium. The frontal area is about two-thirds as long as the glabella, and the brim-border ratio is variable and uncertain because of the ridge.

Free cheeks with long "fish-hook" spines are associated with cranidia of this species, and have been tentatively assigned to it from the time of Owen's original definition. No specimen has been reported in which the course of the facial suture was preserved, and several interpretations of the spines have been made; Hall (1863) was doubtful that the spine belonged to *Idahoia hamulus*. The narrow and strongly convex border of the free cheek, and the fact that the spine apparently originates anterior to the genal angle, suggest *Chariocephalus*, to which a similar cheek with a very short spine has been assigned. However, in accordance with previous writers, the "fish hooks" are here assigned provisionally to *I. hamulus*, but are oriented to express a belief that they originate somewhat anterior to the genal angle, proceed in a posterior or lateral direction, and then bend sharply forward and extend beyond the anterior edge of the cephalon.

Occurrence.—Common in *Prosaukia* subzone at Hell Hollow (F57.1F), Minneiska (F66.2F), Reno (F56.3F), Rileys Coulee (F70.1F), Stockton Hill (F10.2F), Wabasha (F13.1F).

IDAHOIA cf. I. HERA (Walcott)

Plate 32, figures 6a–b

This species, superficially similar to *I. hamulus* differs from it in having a more strongly convex brim, more strongly rounded anterior margin of the cranidium, narrow marginal furrow without ridge, facial sutures more divergent anterior to the palpebral lobes, and in having palpebral furrows that are gently bowed rather than strongly arcuate. The frontal area is about one-half as long as the glabella, and the brim-border ratio is about 2:1.

Assignment to *I. hera* is not made with certainty because topotypes of that species from Marine, Minnesota have a deeper and broader marginal furrow, upsloping and convex border, and a straighter anterior margin of the cranidium. It is our opinion that these specimens from Reads represent a transitional link between typical *Idahoia hera* and *Idahoia* (*Psalaspis*) *marginatus*, n. sp.

Occurrence.—*Ptychaspis granulosa* teil-zone, *Psalaspis* faunule at Reads (F68.1F).

IDAHOIA WISCONSENSIS (Owen)

Plate 37, figures 3a–f

Crepicephalus ? wisconsensis OWEN, 1852, Tab. 1, fig. 13, named and figured.

Conocephalites wisconsensis (Owen) HALL, 1863, p. 164, pl. 7, figs. 39, 41 (not fig. 40 = *I. latafrons*); pl. 8, figs. 22, 23, 27, 28 (not fig. 24 = *Ptychaspis striata*).

Lonchocephalus wisconsinensis (Owen) MILLER 1889, p. 555 (species name misspelled).

Saratogia wisconsensis (Owen) WALTER, 1924, p. 186, pl. 11, figs. 7–9 (probably not fig. 10).

Idahoia wisconsinensis (Hall) RESSER, 1935, p. 35 (Author of species in error and species name misspelled).

Idahoia wisconsensis (Owen) SHIMER & SHROCK, p. 625, pl. 265, fig. 17; LOCHMAN, 1950, p. 329, pl. 46, fig. 11–13.

Not *Ptychoparia* (*Lonchocephalus*) *wisconsensis* WALCOTT, 1889, p. 461, pl. 64, figs. 1, 1a–c. (1, 1a = *Idahoia wyomingensis* Resser; 1b = *I. hamulus;* 1c = *Wilbernia* sp.)

Not *Saratogia wisconsensis* WALCOTT, 1916a, p. 198, pl. 34, figs. 5, 5a–c = *Idahoia wyomingensis* Resser.

This species is distinguished by its typically large size (cranidia commonly are 25 to 30 mm. long), and strongly divergent facial sutures anterior to the palpebral lobes. The frontal area is about three-fourths as long as the glabella, and the brim-border ratio is highly variable. It differs from *I. latafrons* (Shumard) in having a proportionally shorter brim and more strongly divergent facial sutures. It resembles *I. serapio* Walcott, the type species, and possibly further study will demonstrate that the two are conspecific geographic variants.

I. wisconsensis is an abundant associate of *Ptychaspis striata*, a rare associate of the underlying *P. granulosa*, and a very rare associate of the overlying *P. miniscaensis*

(*Prosaukia* subzone). Population studies of more abundant zoned specimens than are now available may help to clarify relationships within the *Ptychaspis-Prosaukia* zone.

Occurrence.—Rare in *Ptychaspis granulosa* teilzone at Lake City (F71.1Bell), Maple Springs (F69.1F,.2Bell), Minneiska (F66.-1B,.2F), Reads (F68.2F). Abundant in *Ptychaspis striata* teilzone at Brownsville (F209.5B), Hell Hollow (F57.2Bell), Lake City (F71.1F,.2Bell), Maple Springs (F69.-2F,.3F), Minneiska (F66.1Bell), Mount Tom (F58.1F), Reno (F56.1F). Rare in *Prosaukia* subzone at Hokah (F54.2F), Rileys Coulee (F70.1F).

Subgenus Psalaspis Resser 1937

Resser's original description of the cranidium is adequate, except that an occipital spine may be present. The free cheek is that of *Idahoia* except that in *Psalaspis patersoni*, the type species, the genal spine is bent sharply backward. The pygidium is transversely diamond-shaped in outline and its axis reaches to the border, which is very narrow and convex.

Type species.—*Conocephalites patersoni* Hall, 1863.

Remarks.—The subgenus *Psalaspis* is essentially a large *Idahoia* that is strongly convex longitudinally and transversely, has a low glabella marked off by a shallow dorsal furrow, may or may not have an occipital spine and marginal furrow, and with a transversely diamond-shaped pygidium having a narrow convex border. The posterior limbs, as in *Idahoia*, are narrow and almost never preserved.

Idahoia cf. *I. hera* of this paper and *Idahoia* (*Psalaspis*) *marginatus* n. sp. are the morphologic links between typical *Idahoia* s. s., represented by *I. wisconsensis*, and typical *Idahoia* (*Psalaspis*), represented by *I.* (*P.*) *patersoni*. *Psalaspis* is known only from Reads, Minn. and several localities across the Mississippi in Wisconsin between Arkansaw and Alma. Usually it and its associates occur underlying and not including *Ptychaspis granulosa* (four years of collecting at Reads have produced one small cranidium of *P. granulosa*), hence the designation "*Psalaspis* fannule," but R. R. Berg has collected *Psalaspis marginata*, typical *Idahoia hera*, and *Ptychaspis granulosa* associated at Arkansaw, Wis. The presence of *Idahoia hera* suggests a close relationship between the *Psalaspis* faunule of the lower Chippewa River valley area and the *Stigmacephalus oweni* faunule described by Nelson (1951) from the St. Croix Valley.

Idahoia (Psalaspis) marginatus
Feniak, n. sp.
Plate 33, figures 3a–c

Psalaspis with a stout occipital spine and a shallow marginal furrow. Free cheek and pygidium unknown.

Holotype.—Cranidium, T6622b, length 21 mm.

Remarks.—Except for the subgeneric characters of strong cranidial convexity coupled with a low and obscure glabella, this species is identical to *Idahoia* cf. *I. hera* of this paper.

Occurrence.—*Ptychaspis granulosa* teilzone, *Psalaspis* faunule at Reads (F.68.1F).

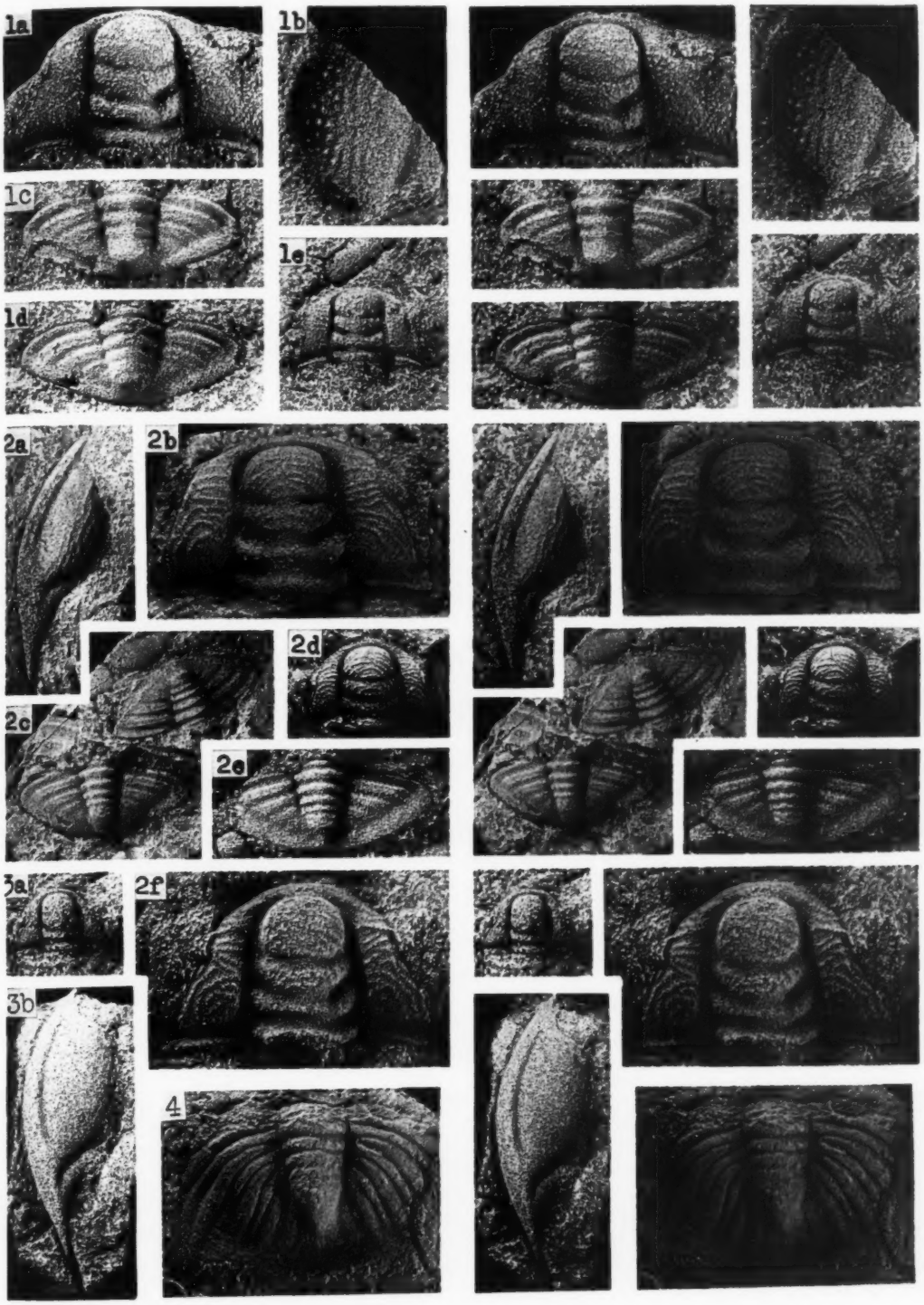
Explanation of Plate 35

Figs. *1a–e*—*Ptychaspis granulosa* (Owen). *1a*, cranidium, ×2, T6632a, Goodenough Hill, Wis.; *1b*, fragment of large free cheek with granules, ×2, T6633d, Reads (F68.2F); *1c*, pygidium, ×2, T6634a, Maple Springs (F69.1F); *1d*, pygidium, ×2, T6633c, Reads (F68.2F); *1e*, small cranidium, ×2, T6633a, Reads (F68.2F). (p. 193)

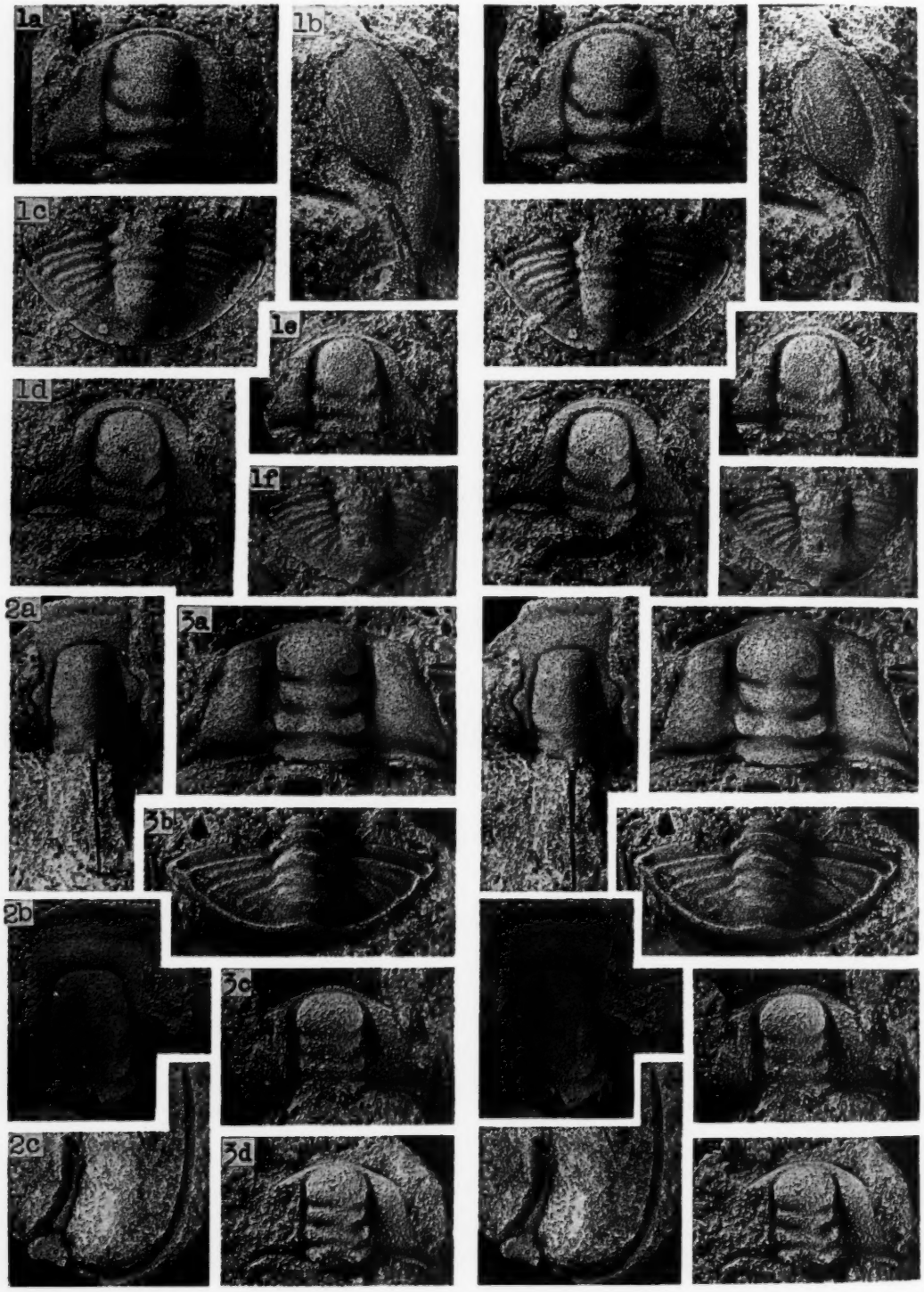
2a–f—*Ptychaspis striata* Whitfield. *2a*, complete free cheek, ×1.5, T6635a, Lake City (F71.1F); *2b*, large cranidium, ×1.5, T6635b, Lake City (F71.1F); *2c*, well preserved pygidia, ×1, T6635c, Lake City (F71.1F); *2d*, wax squeeze of small holotype cranidium figured by Hall (1863, pl. 6, fig. 33), ×3, T6662a, Trempealeau, Wis.; *2e*, topotype pygidium, ×2, T6637a, Trempealeau, Wis., collected by C. R. Stauffer; *2f*, almost perfect cranidium, ×2, T6636a, Maple Springs (F69.3F). (p. 193)

3a–b—*Ptychaspis miniscaensis* (Owen). *3a*, very small cranidium, ×3, T6663a, Reno (F56.4F); *3b*, large free cheek, ×1, T6642a, Alma, Wis., collected by W. A. Finkelnburg. (p. 193)

4—*Dikelocephalus freeburgensis* Feniak, n. sp. Rubber cast of large paratype pygidium showing convex margin and divergent spine, ×1, T6660f, Freeburg (F55.1F). (p. 195)



Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota



Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota

Berg has collected this species from Arkansaw and Misha Mokwa, Wis.

IDAHOIA (PSALASPIS) PATERSONI (Hall)
Plate 33, figures 2a–e

Conocephalites patersoni HALL, 1863, p. 159, pl. 7, figs. 45, 46.
Psalaspis patersoni (Hall) RESSER, 1937, p. 25.

This species differs from *I.* (*P.*) *marginatus*, n. sp. in lacking both an occipital spine and a marginal furrow. The specimens figured here are essentially topotypes, for contrary to Hall's statement (Hall, 1863, p. 159), his types preserved at the American Museum of Natural History came from "3 miles above Reeds Landing-Lake Pepin" rather than from Trempealeau.

Occurrence.—*Ptychaspis granulosa* teilzone, *Psalaspis* faunule at Reads (F68.1F).

Genus MONOCHEILUS Resser 1937

This genus is characterized by its large, smooth glabella, short convex frontal area without marginal furrow, very narrow fixed cheeks, slightly curved broad palpebral lobes that are about two-thirds as long as the glabella, and narrow posterior limbs. It differs from *Stigmacephalus*, which it resembles closely in many respects, in having much longer palpebral lobes and narrower posterior limbs.

MONOCHEILUS ANATINUM (Hall)
Plate 33, figures 5a–c; plate 34, figure 2

Conocephalites anatinus HALL, 1863, p. 158, pl. 7, figs. 34, 35 (not pl. 8, fig. 29 = *Monocheilus micros*).
Monocheilus anatinus (Hall) RESSER, 1937, p. 20.
Monocheilus anatinum (Hall) SHIMER & SHROCK, p. 629, pl. 266, figs. 1–3; NELSON, 1951, p. 778, pl. 110, fig. 15.

Hall's original description is adequate. He did not illustrate the pygidium he described and, by implication, assigned to this species. It occurs on the same slab with the types of *M. anatinum* and *Idahoia* (*Psalaspis*) *patersoni* from "3 miles above Reeds Landing-Lake Pepin," and is illustrated here as Plate 33, figure 5a. The type cranidium (Hall, 1863, pl. 7, fig. 34) designated by Resser (1937, p. 20) is incomplete; the frontal area was restored by Hall from other specimens. The specimens from our Minnesota collections that are illustrated here are essentially topotypes.

Occurrence.—Abundant in *Ptychaspis granulosa* teilzone, *Psalaspis* faunule at Reads (F68.1F). Rare in *Ptychaspis granulosa* teilzone at Lake City (F71.1Bell), Maple Springs (F69.1F, .2Bell), Minneiska (F66.1B, .2B, .1F), Reads (F68.2F). Rare in *Ptychaspis striata* teilzone at Hell Hollow (F57.2Bell), Lake City (F71.2Bell), Maple Springs (F69.2F, .3F), Minneiska (F66.1 Bell).

MONOCHEILUS MICROS (Walter)
Plate 33, figures 4a–c

Conocephalites anatinum HALL, 1863 (part), pl. 8, fig. 29.
Conaspis micros WALTER, 1924, p. 185, pl. 11, figs. 5, 6; pl. 12, fig. 2.
Monocheilus micros (Walter) RESSER, 1937, p. 20.

This species differs from *M. anatinum* in its smaller size, proportionally shorter and less convex glabella, and more elongate frontal area. Though *M. micros* has not been found in Minnesota it occurs across the

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EXPLANATION OF PLATE 36

FIGS. *1a–f*—*Ptychaspis miniscaensis* (Owen). *1a*, medium sized cranidium, ×1.5, T6638a, Minneiska (F66.2F), collected by C. R. Stauffer; *1b*, medium sized fragmentary free cheek with faint striations, ×2, T6640a, Rileys Coulee (F70.1F); *1c*, almost perfect pygidium, ×2, T6641, Stockton Hill (F10.2F); *1d–e*, small cranidia, ×2, T6639a (Reno, R56.2F), T6638b (Minneiska, F66.2F); *1f*, small pygidium, ×2, T6640b, Rileys Coulee (F70.1F). (p. 193)

2a–c—*Idahoia hamulus* (Owen). *2a*, cranidium with occipital spine, ×1.5, T6647a, Wabasha (F13.1F); *2b*, cranidium, ×2, T6646a, Stockton Hill (F10.2F); *2c*, "fish-hook" genal spine attached to fragmentary free cheek, ×1, T6648a, Alma, Wis., collected by W. A. Finkelnburg. (p. 189)

3a–d—*Ptychaspis tuberosa* Feniak, n. sp. *3a*, almost perfect holotype cranidium, ×2, T6643a, Trempealeau, Wis., collected by C. R. Stauffer; *3b*, paratype pygidium with rimlike border, ×2, T6643b, on same slab with holotype; *3c–d*, small cranidia, ×2, T6644a (Victory, Wis.), T6645a (Rileys Coulee, F70.1F). (p. 193)

Mississippi in Buffalo, Trempealeau and Vernon counties, Wis., and at Lansing, Iowa. It is included here for comparison with *M. anatinum*.

Occurrence.—Apparently restricted to *Ptychaspis striata* teilzone.

Genus PROSAUKIA Ulrich & Resser 1933

PROSAUKIA MISA (Hall)

Plate 38, figures 1a–d

Dikelocephalus minnesotensis OWEN, 1852 (part). Tab. 1A, fig. 1.

Dikelocephalus misa HALL, 1863, p. 144, pl. 10, figs. 4, 5, 7, 8.

Conokephalina misa (Hall) WALCOTT, 1914, p. 387, pl. 68, figs. 1–3.

Prosaukia misa (Hall) ULRICH & RESSER, 1933, p. 141, pl. 24, figs. 1–9; SHIMER & SHROCK, 1944, p. 631, pl. 261, figs. 9–11.

Prosaukia halli ULRICH & RESSER, 1933, p. 154, pl. 27, figs. 3–9.

Not *Dicellocephalus misa* BERKEY, 1898, p. 290, pl. 20, figs. 12, 13 (*Wilbernia halli* Resser).

This, the type species of *Prosaukia*, is characterized by its relatively long and flat frontal area. The marginal furrow may be complete or shallow to absent medially; a small occipital node may or may not be present.

Ulrich and Resser (1933) described 30 species of *Prosaukia*, 28 of them from the Franconia formation, of which all but *P. misa* were new. Considerably fewer than 30 valid species are represented, for several are founded on incomplete pygidia, others on poorly preserved cranidia, and the fine distinctions between many of the species do not allow for normal morphologic variation nor for differences due to size and types of preservation. No attempt can be made here to redescribe the genus nor to evaluate all of Ulrich and Resser's species, for most of them were collected from the Mazomanie facies of the Franconia formation, which does not occur in southeast Minnesota.

Prosaukia halli is here placed in synonymy with *P. misa* because among our specimens there is no consistent relationship between a medially shallow marginal furrow and the presence of an occipital node. On some specimens the "shallowing" is clearly the consequence of abrasion, and at least two specimens clearly show a node and a uniformly deep furrow; the node is larger on external than on internal impressions. Probably *P. misa* typically possesses a node, but its small size and its position at the posterior edge of the occipital ring mitigate against its preservation in the sandstones of this area. It is likely that *P. concava* U. & R. and *P. resupinata* U. & R. also belong in synonymy with *P. misa*.

Occurrence.—Common in *Prosaukia* subzone at Hell Hollow (F57.3B,.1F), Lake City (F71.2F), Minneiska (F66.2F), Rileys Coulee (F70.1F), Stockton Hill (F10.2F).

PROSAUKIA? AMBIGUA Ulrich & Resser

Plate 37, figure 5; plate 38, figure 2

Prosaukia? ambigua ULRICH & RESSER, 1933, p. 167, pl. 31, figs. 6–8.

The description of this species, although inadequate must for the present remain unsupplemented for lack of suitable material. For the same reason an accurate determination of the species' generic affinity is impossible. The features of the cranidium however apparently fit *Prosaukia* better than they do those of any other known genus.

Occurrence.—Rare in *Prosaukia* subzone at Hokah (F54.2F), Reno (F56.2F).

Genus PTYCHASPIS Hall 1863

The genus *Ptychaspis* was proposed by Hall (1863, p. 170) to include two species previously described and illustrated by Owen (1852) as *Dikelocephalus miniscaensis* and *D. granulosus*. Hall did not designate either as the type species. Whitfield (1878, p. 55) concluded that Hall's *Ptychaspis granulosa* was not the *Dikelocephalus granulosus* of Owen but a different species to which he assigned the name *Ptychaspis striata*. In 1889 S. A. Miller selected *P. miniscaensis* as the type species. Subsequently Raymond (1924, p. 190) selected *P. striata*, stating that Hall's description of the genus applied more strictly to the species which he described under the name of *P. granulosa* than it did to *P. miniscaensis*. Raymond's selection, in addition to being invalidated by Miller's earlier designation, is not in accord with the rules of nomenclature; *P. striata* could not be the type species because the name was not in existence at the time Hall established his genus. The only alternatives are *Dikelocephalus*

miniscaensis Owen and *D. granulosus* Owen, for they are the only names referred to by Hall at the time he established *Ptychaspis*. In Shimer and Shrock (1944, p. 631) *Dikelocephalus granulosus* Owen is indicated by asterisk to be the type species of *Ptychaspis;* in our opinion this designation could not be valid even in the absence of Miller's earlier selection, because neither the person responsible nor the reasons for making it can be ascertained from the publication—which at best possesses dubious validity as an authority for nomenclatural changes.

PTYCHASPIS GRANULOSA (Owen)
Plate 34, figures 6a–b; plate 35, figures 1a–e

Dikelocephalus granulosus OWEN, 1852, p. 575, Tab. 1, figs. 5, 7.

Ptychaspis granulosa (Owen) WHITFIELD, 1878, p. 54; 1882, p. 185, pl. 1, fig. 24; NELSON, 1951, p. 779, pl. 110, fig. 8.

Not *Ptychaspis granulosa* HALL, 1863, p. 173, pl. 6, figs. 33–40 (33, 37, 38, 40 = *P. striata;* 34, 35 = *P. tuberosa* n. sp.; 36, 39 undetermined); SHIMER & SHROCK, 1944, p. 631, pl. 262, figs. 18–21 (copies of Hall's figs. 35, 37, 38, 34, respectively).

This species is distinguished by its coarsely granular surface, parallel-sided sunken glabella, and steeply downsloping to vertical frontal area. It differs in the last two respects from *P. arcolensis* Nelson, another granular species, which has its glabella slightly elevated above the free cheeks, its frontal area less steeply downsloping, and its palpebral lobes on or posterior to midline of the glabella.

Occurrence.—Very rare in *Ptychaspis granulosa* teilzone, *Psalaspis* faunule at Reads (68.1F). Common in *Ptychaspis granulosa* teilzone at Lake City (F71.1Bell), Maple Springs (F69.1F, .2Bell), Minneiska (F66.2B, .1F), Reads (F68.2F).

PTYCHASPIS MINISCAENSIS (Owen)
Plate 35, figures 3a–b; plate 36, figures 1a–f

Dikelocephalus miniscaensis OWEN, 1852, p. 574, Tab. 1, figs. 3a–b, 12; Tab. 1A, figs. 4, 5.

Ptychaspis miniscaensis (Owen) HALL, 1863, p. 171, pl. 6, figs. 41–46; pl. 10, figs. 21, 22; RAYMOND, 1924, p. 189; SHIMER & SHROCK, 1944, p. 631, pl. 262, fig. 1; NELSON, 1951, p. 779, pl. 110, fig. 20.

This species, as characteristic of the *Prosaukia* subzone as is *Prosaukia,* is distinguished by its smooth surface, relatively gentle downslope of anterior part of cranidium, and tapered glabella with obsolescent anterior furrow. With increase in size, the glabella becomes more tapered, less convex, the frontal area less downsloping, and the glabellar furrows broader.

P. miniscaensis is most like *P. striata* in form and size, but differs from it in having a smooth surface and obsolescent anterior glabellar furrows.

Occurrence.—Common in *Prosaukia* subzone at Hell Hollow (F57.3B, .~~1F~~), Hokah (F54.2F), Minneiska (F66.2F), Reno (F56.2F–.4F), Rileys Coulee (F70.1F), Stockton Hill (F10.2F), Wabasha (F13.1F).

PTYCHASPIS STRIATA Whitfield
Plate 35, figures 2a–f

Ptychaspis granulosa HALL (not Owen), 1863 (part), p. 173, pl. 6, figs. 33, 37, 38, 40 (34, 35 = *P. tuberosa* n. sp.; 36, 39 undetermined); SHIMER and SHROCK, 1944 (part), p. 631, pl. 262, figs. 19, 20 (18, 21 = *P. tuberosa* n. sp.).

Ptychaspis striata WHITFIELD, 1878, p. 55; 1880, p. 51; 1882, p. 186; RAYMOND, 1924, p. 190; WALTER, 1924 (part), p. 195, pl. 11, figs. 12, 13 (11, 14 = *P. tuberosa* n. sp.); SHIMER & SHROCK, 1944, p. 631, pl. 262, fig. 2; LOCHMAN, 1950, p. 330, pl. 47, figs. 1–5.

This species is distinguished by its striated surface, moderate downslope of anterior part of cranidium, and tapered glabella with distinct and continuous anterior glabellar furrow. With increase in size the glabella becomes more tapered.

P. striata is most like *P. miniscaensis;* for comparison see that species.

Occurrence.—Common in *Ptychaspis striata* teilzone at Hell Hollow (F57.2 Bell), Lake City (F71.1F, .2Bell), Maple Springs (F69.2F, .3F), Minneiska (F66.1Bell), Mount Tom (F58.1F), and several exposures south of Reno, Minnesota.

PTYCHASPIS TUBEROSA Feniak, n. sp.
Plate 36, figures 3a–d; plate 37, figure 1

Ptychaspis granulosa HALL (not Owen), 1863 (part), p. 173, pl. 6, figs. 34, 35; pl. 8, fig. 13; SHIMER & SHROCK, 1944 (part), p. 631, pl. 262, figs. 18, 21.

Ptychaspis striata WALTER (not Whitfield), 1924, (part), p. 195, pl. 11, figs. 11, 14.

Cranidium trapezoidal in outline, flat laterally and longitudinally except for

nearly vertical frontal area. Glabella hemicylindrical, bulbous anteriorly, anterior lobe ornamented laterally on large specimens by short transverse ridges. Dorsal furrow very deep at sides, shallow anteriorly. Glabellar furrows two, deep at sides, shallow but distinct across midline, anterior one straight, posterior one bent forward at sides. Occipital furrow strong, curved anteriorly at center. Frontal area flexed sharply downward just anterior to palpebral lobes, almost vertical, barely visible in dorsal view, without marginal furrow. Fixed cheeks horizontal, slightly convex, width slightly more than one-half that of glabella, ornamented near palpebral lobes on large specimens by short transverse ridges. Palpebral lobes short, situated on anterior one-third line of glabella. Posterior limbs broad, short, triangular. Facial sutures convergent anterior to eyes, divergent posterior.

Free cheek not differentiated from that of *P. striata*.

Pygidium transversely semielliptical. Axis consists of four segments, strongly convex transversely, tapering, bluntly rounded posteriorly, extending to border. Border narrow, raised and rimlike, slightly indented behind axis.

Types.—Holotype, cranidium, T6643a, length 11 mm.; paratypes, pygidia, T6643b–c.

Remarks.—This species is distinguished by its bulbous anterior glabellar lobe, proportionally wide fixed cheeks, smooth surface over all of posterior, two-thirds of cranidium, and rimlike pygidial border. Apparently there are no gradational forms between this species and *P. striata*, with which it seems always to be associated.

Occurrence.—Common in *Ptychaspis striata* teilzone at Hell Hollow (F57.2Bell), Lake City (F71.1F, .2Bell), Maple Springs (F69.3F), south of Brownsville, south of Reno, and south of Lansing, Iowa. A single specimen from *Prosaukia* subzone at Rileys Coulee (F70.1F).

STIGMACEPHALUS FLEXIFRONS Feniak, n. sp.
Plate 37, figures 6a–b

Cranidium, excluding posterior limbs, elongate quadrangular in outline, moderately convex longitudinally and transversely, anterior margin broadly rounded. Glabella almost quadrate, moderately convex, slightly tapering, broadly rounded anteriorly, length about two-thirds and width about half length of cranidium. Glabellar furrows obscure or absent. Occipital furrow broad, shallow, gently curved forward on midline, extremities curved forward and terminated before reaching dorsal furrow. Occipital ring wide, widest at middle. Frontal area steeply downsloping, about one-fourth length of cranidium, marginal furrow shallow and curved. Brim strongly convex and downsloping, about twice width of border. Border slightly convex, horizontal longitudinally, moderately downsloping laterally, widest at middle. Fixed cheeks horizontal, narrow, width about one-fourth that of glabella. Palpebral lobes about one-third length of glabella, slightly curved, situated on about midline of glabella. Palpebral furrow faint, curved. Posterior limbs not preserved but evidently moderately wide. Anterior course of facial suture forward, then gently convergent in front of palpebral lobes; posterior course strongly divergent from rear edge of lobes. Free cheeks and pygidium unknown.

Types.—Holotype, cranidium, T6658b, length 13.5 mm.; paratype, cranidium, T6658a.

Remarks.—The generic assignment of this species to *Stigmacephalus* is made because it is similar to topotypes of *S. oweni* s.s. from Marine, Minn. in all respects except character of the frontal area. The similarity to *S. oweni* var. B, Nelson (1951, pl. 108, figs. 10, 11) which also has a brim and border, is even closer, but *S. flexifrons* differs from that variety in having a steeply downsloping frontal area, and a less elongate and pointed glabella. It differs from *S. similis* Kurtz, n. sp. in the same features.

The assignment in this paper of the new species *S. similis* and *S. flexifrons* to the genus *Stigmacephalus* extends its range in Minnesota downward into the upper *Conaspis* zone and upward into the *Ptychaspis striata* teilzone. In southeast Minnesota the *Stigmacephalus oweni* faunule (Nelson, 1951) is unknown, its position locally being occupied by the *Idahoia* (*Psalaspis*) faunule.

Occurrence.—Rare in *Ptychaspis striata* teilzone at Hell Hollow (F57.2Bell), Lake

City (F71.1F), Maple Springs (F69.2F), Minneiska (F66.1Bell).

Genus WILBERNIA Walcott 1924
WILBERNIA EXPLANATA (Whitfield)
Plate 34, figures 4a–e

Conocephalites (*Ptychaspis*?) *explanatus* WHITFIELD, 1880, p. 48; 1882, p. 181, pl. 1, figs. 27, 28.
Ptychoparia ? *diademata* (Hall) WALCOTT, 1899 (part), p. 64, fig. 2c.
Wilbernia hudsonensis RESSER, 1937, p. 28.
Wilbernia explanata (Whitfield) LOCHMAN, 1950. p. 330, pl. 46, figs. 15–17; NELSON, 1951, p. 782, pl. 109, fig. 10.

This can be distinguished from other species of *Wilbernia* known to occur in the *Ptychaspis-Prosaukia* zone of Minnesota and Wisconsin by a brim-border ratio of 1:1. From the *Conaspis* zone *W. halli*, which also may have a brim-border ratio approaching 1:1, this species can usually be distinguished by its more truncate and more nearly parallel-sided glabella.

Occurrence.—*Ptychaspis granulosa* teilzone, *Psalaspis* faunule at Reads (F68.1F). This association is another link between the *Psalaspis* faunule and the *Stigmacephalus oweni* faunule of the St. Croix valley (Nelson, 1951).

WILBERNIA cf. W. PERO (Walcott)
Plate 34, figures 5a–c

The specimens grouped under this heading number seven cranidia from four different collections and two teilzones. They are characterized by a strongly convex and rectangular glabella, little or no brim, a shallow papillate marginal furrow, and a wide and convex border. Feniak (1948) believes they represent a new species, and he may be right, but until the genus *Wilbernia* is better understood than it is now, the erection of a new species so closely similar to the type species seems unwise. The monographing of *Wilbernia* will be a difficult chore that must have as a basis large collections of accurately zoned specimens; "species" now identified in Minnesota and Wisconsin either are loosely conceived or based on very few specimens.

Occurrence.—Rare in *Ptychaspis granulosa* teilzone at Maple Springs (F69.1F). Rare in *Ptychaspis striata* teilzone at Lake City (F71.1F), Maple Springs (F69.3F).

DIKELOCEPHALUS POSTRECTUS ZONE

Genus DIKELOCEPHALUS Owen 1852
DIKELOCEPHALUS FREEBURGENSIS
Feniak, n. sp.
Plate 35, figure 4; plate 38, figures 4a–e

Cranidium, excluding posterior limbs, quadrangular in outline, moderately convex transversely and longitudinally, broadly to strongly rounded anteriorly. Glabella moderately convex, rectangular, parallel-sided, truncate anteriorly, length and width slightly over half that of cranidium. Dorsal furrow deep at sides, shallow around anterior of glabella. Glabellar furrows moderately impressed, anterior pair absent, second pair straight and not connected, posterior pair bent backward and connected. Occipital furrow narrow, straight, complete. Occipital ring narrow. Frontal area downsloping to horizontal, length less than one-third that of cranidium, divided into brim and border by faint and indefinite marginal furrow. Brim concave, almost twice as long as border in larger specimens. Border gently convex, broadest in middle. Fixed cheeks upsloping, width slightly more than one-third that of glabella. Palpebral lobes moderately large, strongly arcuate, length almost half that of glabella, situated behind midline of glabella. Palpebral furrow deep, strongly arcuate. Posterior limbs narrow, parallel-sided. Anterior course of facial suture strongly divergent immediately in front of palpebral lobes, then sharply curved toward midline; posterior course almost straight laterally from point behind palpebral lobes. Free cheek with long spine and convex border.

Pygidium transversely ovoid in outline, posterolateral corners projected into stout and slightly divergent short spines, posterior margin gently convex. Axis moderately convex, length three-fourths that of pygidium, consists of five segments, the fourth and fifth obscurely separated and together constituting one-half length of axis. Pleural furrows and interpleural grooves distinct axially, die out on border, three pairs clearly defined. Border gently concave, poorly defined, smooth except for faint termination of pleural furrows, length on axis about one-fifth that of pygidium. Doublure long, extending anteriorly beyond termina-

tion of axis, its impression preserved on most internal molds and creating appearance of a very broad border.

Type.—Holotype, cranidium, T6660e, length 33 mm.; paratype, pygidium, T6660f.

Remarks.—This species differs from *D. postrectus* Ulrich and Resser, the only other described pre-St. Lawrence species, in its convex rather than straight pygidial margin, and apparently in having a proportionally longer pygidial axis. Comparison with the multitude of Trempealeauan species defined by Ulrich and Resser (1930) is fruitless at present.

Associated with *D. freeburgensis* are fragmentary pygidia, of which that illustrated on Plate 38, figure 4b is one, whose straight lateral margins and apparently straight posterior margin relate it to *D. postrectus*. However, because our specimens are poorly preserved, and because the only known specimen of *D. postrectus* Ulrich and Resser (1930, pl. 20, figs. 1, 2) does not have the lateral margins preserved, an assignment to that species is not made.

Occurrence.—Moderately common in *Dikelocephalus postrectus* zone at Freeburg (F55.1F), Hell Hollow (F57.4B), Stockton Hill (F10).

Genus Illaenurus Hall 1863
Illaenurus truncatus Feniak, n. sp.
Plate 38, figures 3a–b

Cranidium, excluding posterior limbs, quadrate in outline, moderately convex longitudinally, gently convex transversely, slightly wider than long, anterior margin straight. Glabella and occipital ring apparently not differentiated. Palpebral lobes small, situated on midline of cranidium. Posterior limbs short, triangular. Anterior course of facial suture straight in front of palpebral lobe; posterior course strongly divergent.

Holotype.—Cranidium, T6659a, length 9.5 mm.

Remarks.—This species differs from *I. quadratus* Hall in being in fact quadrate to slightly wider than long rather than slightly elongate, and in having the palpebral lobes situated on the midline of the cranidium rather than behind it.

Occurrence.—Rare in *Dikelocephalus postrectus* zone at Freeburg (F55.1F), Hell Hollow (F57.4B).

APPENDIX

Genus Pseudagnostus Jaekel 1909
Pseudagnostus josepha (Hall)
Plate 32, figures 4a-b; plate 33, figure 1

Agnostus josepha Hall, 1863, p. 178, pl. 6, figs. 54, 55.

Pseudagnostus josepha (Hall) Nelson, 1951, p. 776, pl. 107, fig. 5 (for complete synonymy).

This species is ubiquitous throughout the *Conaspis* and *Ptychaspis-Prosaukia* zones. Hall's types, which we have seen, came from the beautifully preserved *Ptychaspis striata* assemblage at Trempealeau, Wis.; topotypes are illustrated here on Plate 33, figure 1.

The only other agnostid described from the Franconia rocks of Minnesota and Wisconsin is *Agnostus parilis* Hall 1863, and so

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Explanation of Plate 37

Fig. *1*—*Ptychaspis tuberosa* Feniak, n. sp. Wax squeeze of topotype pygidium figured by Hall (1863, pl. 8, fig. 13), ×2, T6643c, Trempealeau, Wis. (p. 193)

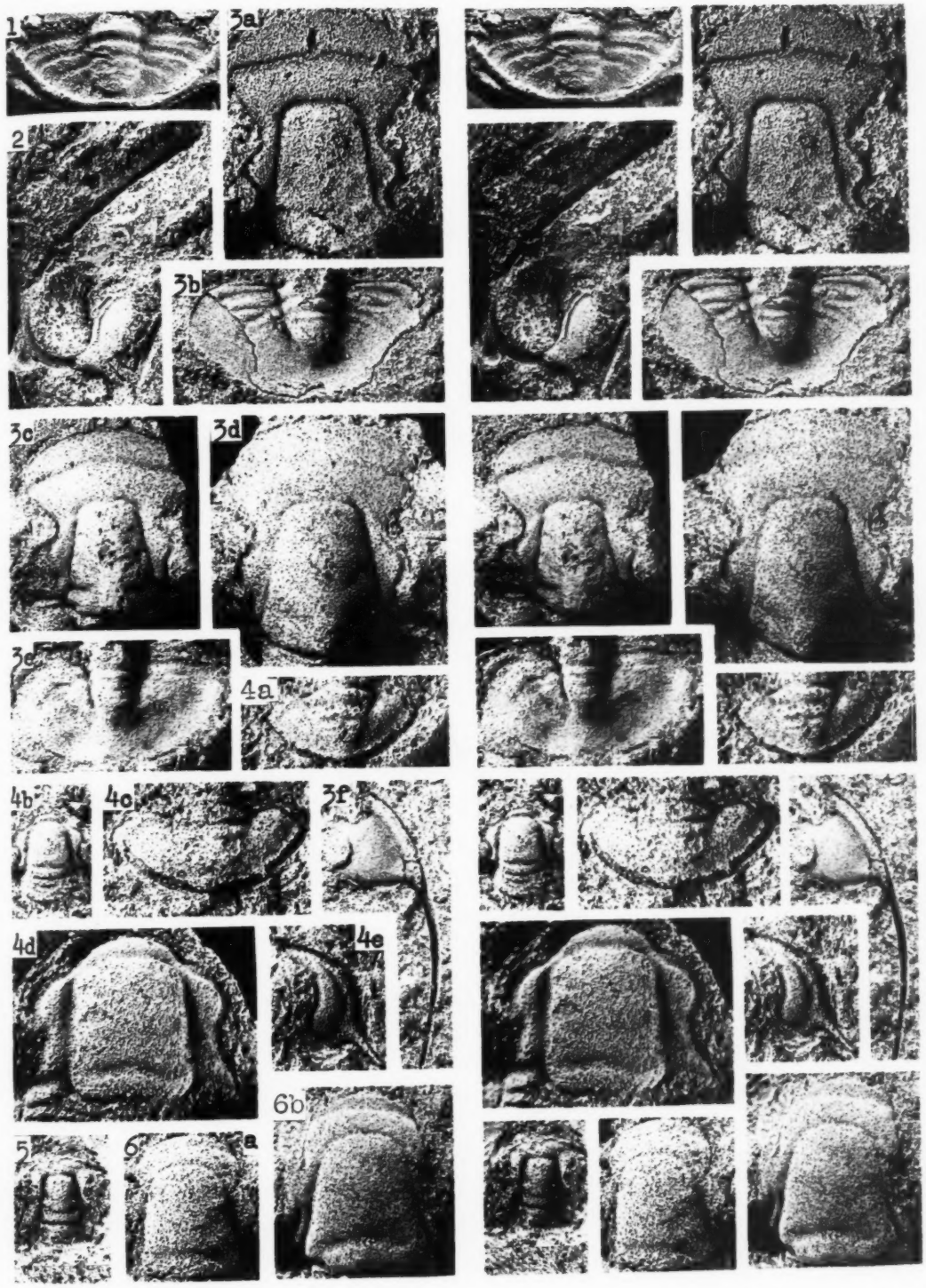
2—*Idahoia hamulus* (Owen). "Fish-hook" genal spine attached to fragmentary free cheek, ×1, T6646b, Stockton Hill (F10.2), collected by C. R. Stauffer. (p. 189)

3a–f—*Idahoia wisconsensis* (Owen). *3a, c*, medium-sized, and large cranidia showing variation in frontal area, ×2, ×1, T6649a–b, Maple Springs (F69.3F); *3b, e*, large and medium-sized pygidia, ×1, ×1.5, T6650c–d, Lake City (F71.1F); *3d*, large cranidium showing base of occipital spine, ×1.5, T6650a, Lake City (F71.1F); *3f*, almost complete free cheek, ×1, T6650b, Lake City (F71.1F). (p. 189)

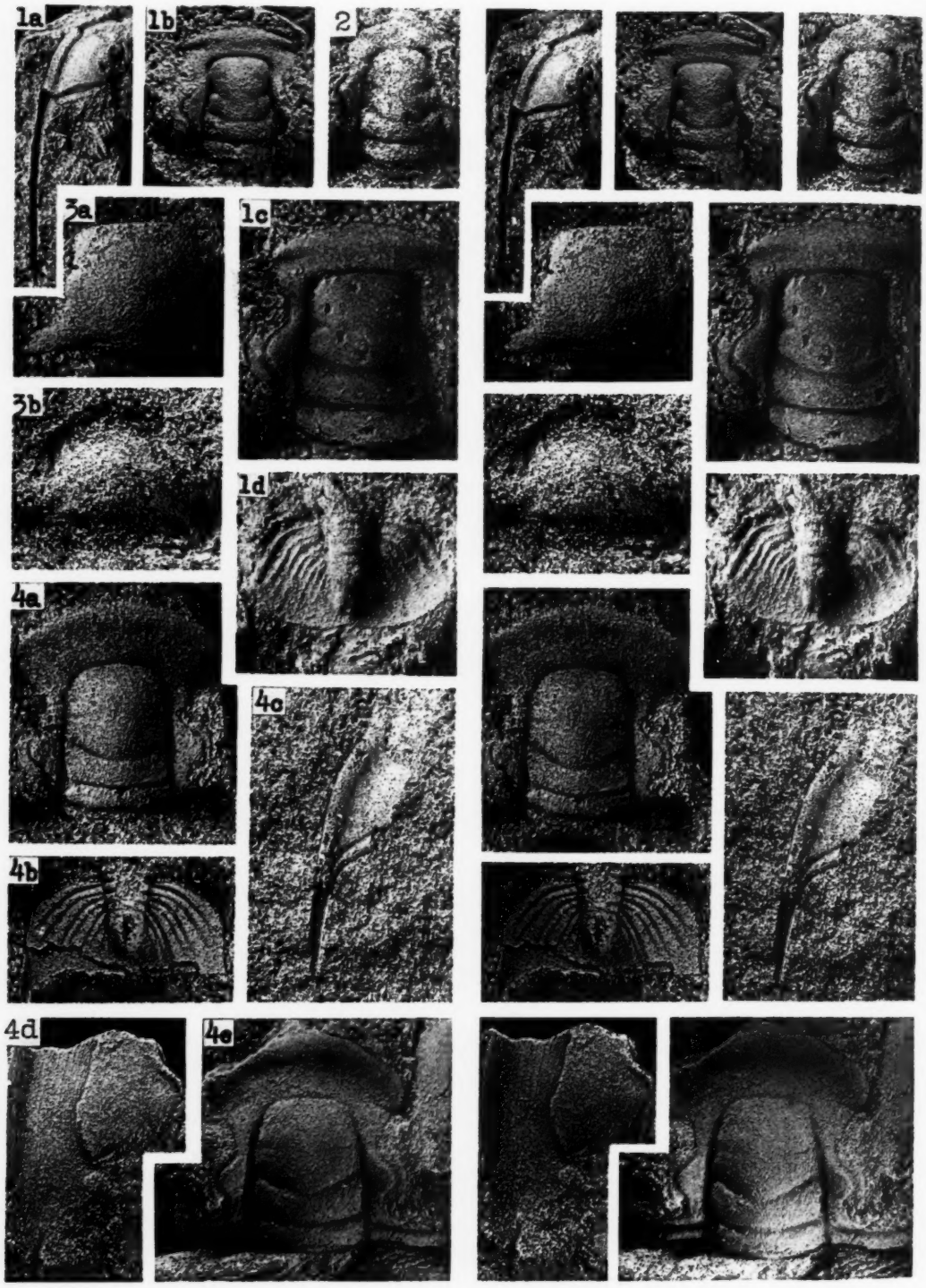
4a–e—*Chariocephalus whitfieldi* Hall. *4a, c*, typical pygidia, ×2, T6651b (Rileys Coulee, F70.1F), T6652b (Minneiska, F66.2F); *4b, d*, small and large cranidia, ×2, T6653a (Reno, F56.4F), T6651a (Rileys Coulee, F70.1F); *4e*, free cheek, ×2, T6652a, Minneiska (F66.2F). (p. 188)

5—*Prosaukia ? ambigua* Ulrich and Resser. Fragmentary small cranidium, ×2, T6654a, Reno (F56.2F). (p. 192)

6a–b—*Stigmacephalus flexifrons* Feniak, n. sp. Fragmentary paratype and holotype cranidia, ×2, T6658a–b, Lake City (F71.1F). (p. 194)



Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota



Bell, Feniak and Kurtz, Cambrian Trilobites from Minnesota

far as we are aware only Walter (1924, p. 184, pl. 10, figs. 10, 11; pl. 12, fig. 1) has subsequently identified it in this area. His specimens occur in a *Ptychaspis striata* assemblage, but his figures are so heavily retouched as to be useless. We have not seen Hall's types, and his locality description ("on the shores of Lake Pepin") and stratigraphic discussion are peculiarly uninformative for him. His description is that of a smooth agnostid with faint and indefinite surface features, and his figures with their stippled furrows are out of character. Our tentative conclusion is that the name *Agnostus parilis* has been applied to poorly preserved and abraded abdominal shields of *Pseudagnostus josepha*, such as those on Plate 32, figures 4a–b. The two types commonly occur together, and the poorer the preservation the higher the proportion of smooth shields. However, until Hall's types can be seen we reserve final judgment.

Occurrence.—Common in *Conaspis* zone at Dakota (F8.2K), Hell Hollow (F57.2K), La Crescent (F59.5K), Mount Tom (F58.2K). Common in *Ptychaspis granulosa* teilzone, *Psalaspis* faunule at Reads (F68.1F). Rare in *Ptychaspis granulosa* teilzone at Maple Springs (F69.1F, .2 Bell), Minneiska (F66.2B, .1F), Reads (F68.2F). Rare in *Ptychaspis striata* teilzone at Hell Hollow (F57.2 Bell), Lake City (F71.1F, .2 Bell), Minneiska (F66.1 Bell), and south of Reno. Rare in *Prosaukia* subzone at Hell Hollow (F57.1F), Hokah (F54.2F), Reno (F56.4F). These estimates of abundance are very approximate, for agnostids are least likely to be noticed and collected from Franconia sandstones.

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EXPLANATION OF PLATE 38

FIGS. *1a–d*—*Prosaukia misa* (Hall). *1a*, almost complete free cheek, ×1, T6657a, Alma, Wis., collected by W. A. Finkelnburg; *1b–c*, small and large cranidia, the former showing a faint occipital node, ×2, T6655a–b, Hell Hollow (F57.1F); *1d*, rubber cast of pygidium, ×2, T6656a, Stockton Hill (F10.2), collected by C. R. Stauffer. (p. 192)

2—*Prosaukia ? ambigua* Ulrich and Resser. Fragmentary large cranidium, ×2, T6654b, Reno (F56.2F). (p. 192)

3a–b—*Illaenurus truncatus* Feniak, n. sp. Fragmentary holotype and paratype cranidia, ×2, T6659a–b, Freeburg (F55.1F). (p. 196)

4a–e—*Dikelocephalus freeburgensis* Feniak, n. sp. *4a*, small paratype cranidium, ×2, T6660a; *4b*, small pygidium with straight lateral margins that may belong to *D. postrectus*, ×2, T6660b; *4c*, small free cheek, ×1.5, T6660c; *4d*, fragment of large free cheek showing wide doublure, ×1, T6660d; *4e*, large complete holotype cranidium, ×1, T6660e. All specimens from Freeburg (F55.1F). (p. 195)

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OSTRACODE GENERA *CYTHERETTA* AND *PARACYTHERETTA* IN AMERICA

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ABSTRACT—Twenty-eight species and varieties of the ostracode genus *Cytheretta* have been reported from North America, ten of them under the generic name *Cythere*. A new species, *C. sahnii*, is reported and a new name, *C. ulrichi*, is proposed for *Cythere plebeia* Ulrich and Bassler which is preoccupied. Six reticulate species previously included in the genus *Cytheretta* are here placed under the genus *Paracytheretta* and are also described and figured. Two charts, based on the examination of material from 52 localities, show the stratigraphic ranges of the species of the genera *Cytheretta* and *Paracytheretta*.

INTRODUCTION

Cytheretta is a common ostracode genus in the Cenozoic with a known range from the Eocene to the Recent. Twenty-eight species and varieties have been reported from North America, ten of these under the generic name *Cythere*. Twenty-one are valid. Of them, seven are reticulate (*C. karlana, C. reticulata, C. choctawhatcheensis, C. gardneri, C. calhounensis, C. jeffersonensis,* and *C. howei*) and belong to the genus *Paracytheretta* which Triebel (1941, p. 388) erected for the reception of such species. Ulrich and Bassler described ten species and varieties, all new, from the Miocene of Maryland under the generic name *Cythere*. Five of these are invalid. Their *C. nitidula* is the young moult of *C. burnsi; C. nitidula calvertensis* is the young moult of *C. inaequivalvis; C. plebeia capax* is merely a worn specimen of *C. plebeia; C. porcella* is the moult of *C. plebeia* and *C. tuomeyi* is the young moult of *C. paucipunctata*. Cushman (1906) described a new species, *Cytheretta edwardsi*, which he placed under the new genus *Pseudocytheretta* erected by him on anatomical differences alone. Howe et al (1935) described two new species and a variety of *Cytheretta* (*C. bassleri, C. karlana* and *C. karlana choctawhatcheensis*) from the Miocene of Florida. *C. karlana choctawhatcheensis* belongs to *Paracytheretta* and is here raised to specific rank. Howe and Chambers (1935) described *C. alexanderi, C. catahoulana* and *C. catahoulana pyeatti*, the latter two under the generic name *Cythereis*, from the Louisiana Jackson Eocene. *C. catahoulana* and *C. catahoulana pyeatti* are young moults of *C. alexanderi* and are therefore included in the synonmy of *C. alexanderi*. Smith (1941) described five species of *Cytheretta: C. gardneri, C. dalli, C. calhounensis, C. spencerensis* and *C. okaloosaensis* from the Florida Miocene. Two of these, *C. gardneri* and *C. calhounensis*, are reticulate and belong to *Paracytheretta*. Edwards (1944) reported a new species, *Cytheretta reticulata*, from the Miocene of North Carolina. It is reticulate and belongs to *Paracytheretta*. Stephenson described the new species, *C. jeffersonensis* (1944) from the subsurface Oligocene and *C. tyusensis* (1946) from the Weches Eocene. *C. jeffersonensis* is a *Paracytheretta*. Swain (1946) reported a new species, *C. daytonaensis*, from the Ocala Eocene and a new reticulate form, *C. howei*, which is a *Paracytheretta*, from Oligocene sub-surface of Florida. To amplify the characters of *Paracytheretta*, four species, *P. calhounensis, P. choctawhatcheensis, P. daniana*, and *P. howei* are redescribed. A new species, *Cytheretta sahnii*, is reported and *C. inaequivalvis, C. plebeia* and *C. paucipunctata* are redescribed. A new name, *C. ulrichi*, is proposed for *C. plebeia* (Ulrich and Bassler) which is preoccupied by *Cythere* (*Bairdia*) *plebeia* (Reuss) of Jones.

TYPES

Holotypes and cotypes are deposited in the Henry V. Howe collection, School of Geology, Louisiana State University, Baton Rouge, La.

ACKNOWLEDGEMENTS

Deep gratitude is expressed to Dr. Henry V. Howe, Director, School of Geology, Louisiana State University, Baton Rouge, La., for his guidance, suggestions, and also for the supply of material which formed the basis of the present study. The author is also grateful to Dr. Robert O. Vernon for the use of some of his samples donated to Dr. Howe.

HISTORY OF THE GENUS

The genus *Cytheretta* was described by G. W. Müller (1894, p. 382) on the basis of one Recent species, *C. rubra*, the genotype from the Gulf of Naples as follows:

The genus is closely related to *Cythereis*, but it is different in the following points. The inner margin has a very irregular course, forms in front an "S" line, at the ventral margin below the adductor muscle insertion it forms a conical figure, behind which it forms an irregular, flat arch, opening towards the bottom. It coincides completely with the line of concrescence. Flagellum of the second antenna in both sexes with three segments. First foot of male on the outer margin with only one seta. Penis with long, free copulatory tube.

Cythereis, as now understood, is not a living genus. Müller's comparison to it refers to the subsequently described genus, *Hemicythere* Sars (1925).

Cushman (1906, p. 382) described a new genus, *Pseudocytheretta*, based on a single species, *P. edwardsi*, from Vineyard Sound, Mass., as follows:

Inner border of the shell irregular with an S-shaped line as in *Cytheretta* but less prominent; a similar angle below the adductor muscle insertion, and likewise with the flat arch of *Cytheretta;* flagellum of the antenna 3-jointed; first foot of the male with a seta on the hinder border, left and right first feet of the male greatly different, the last joint of the first foot of the right side being elongated and greatly broadened on the inner border, the extension thus formed equalling in length the sum of the two joints preceding.

Müller (1912, p. 366) considered *Pseudocytheretta* to be a true *Cytheretta* since it could not be distinguished on the shell structure alone, the major differences being in the soft parts. From the standpoint of paleontology, Müller's conclusions are sound.

Triebel (1941, p. 388) separated reticulate species from *Cytheretta* and erected the genus *Paracytheretta* for their reception including in it forms similar in structure to *Cythereis* and *Protocythere* and similar to *Cytheretta* in the form of the hinge and in the course of the inner margin. The following generic description has been translated by the author from the original German:

A genus of the family *Cytheridae*, in outline and sculpture is similar to the genera *Cythereis* and *Protocythere* but corresponds to the genus *Cytheretta* in the formation of the hinge structure and in course of the inner margin.

The left valve is larger than the right. It overlaps the latter on the ventral margin and at both cardinal angles, especially at the anterior one, where a distinct hinge socket of the left valve is developed. The posterior end of the carapace is made up of a cylindrically rounded, laterally compressed process. The upper surface bears a strong ornamentation of ribs which may form a network. Besides these longitudinal ribs, there is as a rule a distinct marginal lip present.

The marginal area of both valves is extremely broad. It has long pore canals with outstanding margins. The inner margin coincides with the line of concrescence. It does not run parallel to the outer margin but forms several protuberances. The hinge is similar to *Cythereis*, but is distinguished in the following points: the anterior hinge tooth of the right valve is not notched; with or without a sharp edge which if present turns backwards and runs obliquely downwards from above. Both hinge sockets of the valve are not bounded by the close bar from the hollow space of the carapace.

Range of *Paracytheretta* is given by Triebel (1941) as Tertiary, but Van den Bold (1946) stated it to be Cretaceous to Oligocene. In the American Tertiary, the genus is rather restricted. It first appears in the middle Oligocene (sub-surface) represented only by two species, *P. jeffersonensis* and *P. howei*, and extends to the Recent as represented by *P. daniana*. It is quite common in the Miocene. *Cytheretta*, however, has a much

greater range. It first appears in the Weches Eocene as represented by *C. tyusensis* and extends to the Recent seas. The genotype, *C. rubra*, is a living form.

LIST OF LOCALITIES

1. Chipola. NE¼ NE¼ Sec. 20, T. 1 N., R. 16 W., Washington County, Florida.
2. Chipola. SE¼ SE¼ Sec. 5, T. 1 N., R. 16 W., Washington County, Florida.
3. *Arca* Zone. W. E. Collin's farm, SE¼ NE¼ Sec. 15, T. 2 N., R. 15 W., Washington County, Florida.
4. *Cancellaria* Zone. Gully pond, southeast of Greenhead, Washington County, Florida, on Sales-Davis Lumber Company property in center N½ NW¼ NE¼ Sec. 14, T. 1 N., R. 14 W., approximate elevation 59 feet.
5. Chipola. SE¼ SE¼ Sec. 8, T. 3 N., R. 16 W., Chimney Quarry, Washington County, Florida.
6. Chipola. SE¼ SE¼ Sec. 5, T. 1 N., R. 16 W., Washington County, Florida.
7. *Cancellaria* Zone. In small sink south of road NW¼ SW¼ Sec. 7, T. 1 N., R. 13 W., Washington County, Florida.
8. *Cancellaria* Zone. One quarter mile below Gainer's Bridge, Econfina Creek, SW¼ SE¼ Sec. 33, T. 1 N., R. 13 W., Washington County, Florida.
9. *Cancellaria* Zone. Blue Sink, center NE¼ Sec. 14, T. 1 N., R. 14 W., Washington County, Florida.
10. *Cancellaria* Zone. Clarke's Pond, NE¼ SE¼ SW¼ Sec. 12, T. 1 N., R. 12 W., Washington County, Florida.
11. *Arca* Zone. SW¼ NE¼ SW¼ Sec. 16, T. 2 N., R. 15 W., Washington County, Florida.
12. *Arca* Zone. NW¼ SE¼ Sec. 16, T. 2 N., R. 15 W., Spring, 100 yards east of road, Washington County, Florida.
13. *Arca* Zone. SW¼ NW¼ Sec. 15, T. 2 N., R. 15 W., Washington County, Florida.
14. *Arca* Zone. SE¼ SW¼ NE¼ Sec. 15, T. 2 N., R. 15 W., Washington County, Florida.
15. *Arca* Zone. NW¼ SW¼ Sec. 15, T. 2 N., R. 15 W., Washington County, Florida.
16. *Arca* Zone. NE¼ SW¼ Sec. 16, T. 2 N., R. 15 W., Washington County, Florida.
17. Chipola. 1 mile below Scott's Bridge, NE¼ of Sec. 27, T. 2 N., R. 12 W., Bay County, Florida.
18. *Ecphora* Zone. ½ mile above Walsingham Bridge, SW¼ Sec. 11, T. 1 N., R. 13 W., Washington County, Florida.
19. *Ecphora* Zone. ¼ mile above Walsingham Bridge, SE¼ Sec. 10, T. 1 N., R. 13 W., Washington County, Florida.
20. *Ecphora* Zone. 220 yards above Walsingham Bridge, Econfina Creek, NE¼ Sec. 15, T. 1 N., R. 13 W., Washington County, Florida.
21. Chipola. 220 yards below Walsingham Bridge, NE¼ Sec. 15, T. 1 N., R. 13 W., Washington County, Florida.
22. Chipola. 1 mile above Gainer's Bridge, NW¼ Sec. 34, T. 1 N., R. 13 W., Washington County, Florida.
23. *Cancellaria* Zone. ½ mile above Gainer's Bridge, SE¼ NE¼ Sec. 33, T. 1 N., R. 13 W., Washington County, Florida.
24. *Cancellaria* Zone. 330 yards above Gainer's Bridge, Econfina Creek, NE¼ SE¼ Sec. 33, T. 1 N., R. 13 W., Washington County, Florida.
25. Chipola. In ravine 200 yards east of Holmes Creek, NW¼ NE¼ Sec. 28, T. 2 N., R. 16 W., Washington County, Florida.
26. Chipola. NE¼ SW¼ Sec. 28, T. 2 N., R. 16 W., Washington County, Florida.
27. Chipola. At Red Head Still, NE¼ NW¼ Sec. 20, T. 1 N., R. 16 W., Washington County, Florida.
28. Type Oak Grove. At old saw-mill near Oak Grove, right bank of Yellow River, about 100 yards below bridge on Laurel Hill-Oak Grove road, Okaloosa County, Florida.
29. Chipola. Lassiter Landing, Choctawhatchee River, SE¼ SE¼ Sec. 13, T. 2 N., R. 17 W., Washington County, Florida.
30. Chipola. 1¾ miles below Scott's Bridge, Econfina Creek (? NE¼ NW¼ Sec. 28, T. 2 N., R. 12 W.), Bay County, Florida.
31. *Cancellaria* Zone. NE¼ Sec. 16, T. 1 S., R. 13 W., Moccasin Creek beneath bridge, Bay County, Florida.
32. Chipola. Tenmile Creek, Calhoun County, Florida, 4 miles south of Willis, Florida. Collected by Carroll Cook, Standard Oil Co. (N.J.).
33. Type Chipola. Tenmile Creek, from bridge to one-half mile below bridge on the Marianna-Clarksville road, 22 miles south of Marianna, Calhoun County, Florida.
34. *Ecphora* Zone. Jackson Bluff. Near top of section, Ocklocknee River, Leon County, Florida.
35. *Ecphora* Zone. Jackson Bluff. Top shell bed, Oklocknee River, Leon County, Florida.
36. Oak Grove. Senterfiet's or Tanner's Mill (abandoned), 4 miles southwest of Laurel Hill, Okaloosa County, Florida.
37. *Ecphora* Zone. *Pecten* Bed. Jackson Bluff, Oklocknee River, Leon County, Florida.
38. Shoal River. Small gully, 50 feet south of road, 150 feet east of bridge over White's Creek on Eucheeana-Knox Hill road, 1 mile west of Valley Church, Walton County, Florida.
39. Shoal River. Small branch ¼ mile southeast of residence of J. T. G. McClellan, about ⅜ mile west of shell bluff on Shoal River, type locality. Collected by Karl C. Young.
40. Type *Yoldia* zone. Frazier's farm, SE¼ Sec. 18, T. 2 N., R. 19 W., Walton County, Florida.

41. *Ecphora* Zone. Harvey Creek, ½ mile above old well at "Swimming Hole" (5 ft. below water), Leon County, Florida.
42. Choctawhatchee. Pit of West Florida Power Company, just east of road at Power dam, about 300 feet east of Hydro-electric plant near Ward, Florida. Collected by Karl E. Young.
43. *Arca* Zone. Flournoy's old mill, NE¼ Sec. 34, T. 3 N., R. 18 W., elevation 164 feet, Holmes County, Florida.
44. Upper Chickasawhay. Paynes Hammock. Mississippi Geological society, Field Trip No. 6, Stop #19, Mississippi.
45. Plum Point, West side Chesapeake Bay, cliff 1 mile south of Plum Point, 6 feet above base, Maryland.
46. Plum Point, West side Chesapeake Bay, cliff 1 mile south of Plum Point, 36 feet above base, Maryland.
47. *Yoldia* Zone. Upper 10 feet exposed at small dripping spring on Chester Spence farm, NE¼, NE¼ Sec. 17, T. 2 N., R. 19 W., Walton County, Florida.
48. Lower Jacksonian. Grand View Bluff, Ouachita River, Caldwell Parish, Louisiana. Collected by R. W. Harris.
49. Lower Jacksonian. Caney Point marl member, White Bluff formation, Van Mann Gulleys. Banks of several small intermittent streams beginning 50 feet east of local Carmel-Johnville road, 4 miles south of junction of this road and Arkansas State Highway No. 15 at Carmel, 200–250 feet east of house of Mr. Van Mann, approximately in NE¼ Sec. 17, T. 14 S., R. 9 W., Bradley County, Arkansas. Collected by L. J. Wilbert, Jr.
50. Upper Jacksonian. *Massilina pratti* Zone. Danville Landing, Ouachita River, Catahoula Parish, Louisiana. Collected by H. V. Howe.
51. Pliocene. Caloosahatchee marl, left bank of Caloosahatchee River at Ayer's Landing, 5 miles down stream from La Belle, Hendry County, Florida. Collected by Karl E. Young.
52. Recent. Port au Prince, Haiti. Collected by C. P. Dunbar.

SYSTEMATIC DESCRIPTIONS

Order OSTRACODA Latreille

Suborder PLATYCOPA Sars

Family CYTHERIDAE Baird

Subfamily CYTHERINAE Dana

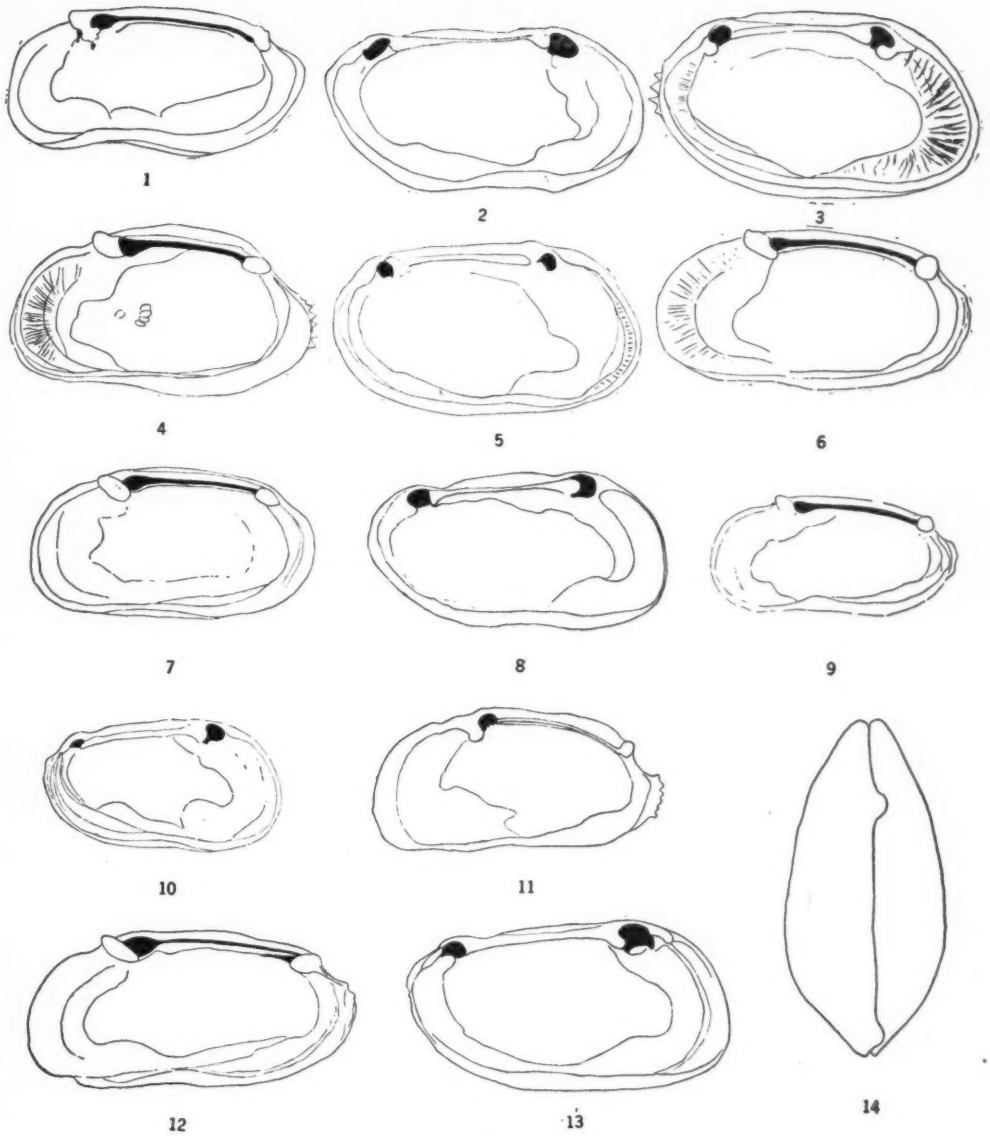
Genus CYTHERETTA G. W. Müller

Cytheretta MÜLLER, 1894, p. 382; 1912, p. 366; EDWARDS, 1944, p. 524; VAN DEN BOLD, 1946, p. 27.
Pseudocytheretta CUSHMAN, 1906, p. 382.
Cylindrus NEVIANI, 1928, pp. 106, 107.

Genotype: Cytheretta rubra MÜLLER 1894, p. 382, pl. 8, figs. 9, 10, 13, 16; pl. 39, figs. 8–22, 24.

Carapace elongate ovate, left valve larger than right, differently shaped, overlapping right valve at cardinal angles and just anterior to middle of ventral margin. Anterior broadly rounded. Posteroventral margin curves upward with posterior extremity at or above middle. Surface smooth, pitted or ribbed. Hinge of right valve with anterior tooth, postjacent socket and a posterior tooth with dorsal margin grooved in between. Hinge of left valve with deep rounded anterior socket, long bar-like tooth, widest and highest anteriorly, middle portion grooved and narrower, terminated abruptly by deep, oval, posterior socket. Marginal area very broad and irregular. Line of concrescence coinciding with inner margin and forming S-shaped curve in anteroventral regions. Radial pore canals rather numerous, thin, curved, closely spaced, frequently crossing, often slightly thickened in middle. Muscle scar pattern consisting of a row of four elongate scars centrally located and an anterior heart-shaped scar. Range: Eocene to Recent.

The Miocene species of the Gulf Coastal Plain may be divided into three closely related groups. In the first the surface is essentially smooth but sometimes shows faint pits, as in *C. ulrichi*. In the second, at least the central portion of the carapace shows strong, longitudinally arranged pits as in *C. burnsi*. The third group possesses longitudinal ridges similar to *Paracytheretta* but the actual surface is smooth, polished and almost porcellanous in appearance. The earliest member of the last group is *C. okaloosaensis* which appears in the Chipola and the type Oak Grove of Florida. It is much smaller and much less triangular than *C. inaequivalvis*, which appears to characterize the Shoal River Miocene of Florida and is more triangular than any other member of this group. *C. bassleri* is the largest species of the group and possesses the most subdued ornamentation. It is restricted to the *Arca* zone of the Choctawhatchee Miocene of Florida. *C. sahnii*, which occurs in the *Ecphora* and *Cancellaria* zones of the upper Miocene Duplin formation of Florida, is very similar to *C. bassleri* but is more elongate, particularly in the right valve,



EXPLANATION OF TEXT FIGURES *1–14*

All figures ×45.

FIGS. *1, 2—Cytheretta sahnii* Puri n. sp. Fig. *1*, right valve, paratype, no. 977; fig. *2*, left valve, holotype, no. 976. (p. 206)

3, 4—Cytheretta paucipunctata (Ulrich and Bassler). Fig. *3*, left valve, paratype, no. 969; fig. 4, right valve, paratype, no. 970. (p. 204)

5, 6, 7—Cytheretta ulrichi Puri, n. name. Fig. *5*, left valve, paratype, no. 972; fig. *6*, right valve, paratype, no. 973; fig. *7*, right valve, paratype, no. 971. (p. 204)

8—Paracytheretta karlana (Howe and Pyeatt), left valve, plesiotype, no. 986. (p. 209)

9, 10—Paracytheretta calhounensis (Smith). Fig. *9*, right valve, paratype, no. 997; fig. *10*, left valve, paratype, no. 996. (p. 211)

11—Paracytheretta daniana (Brady), right valve, paratype, no. 994. (p. 210)

12, 13, 14—Paracytheretta howei (Swain). Fig. *12*, right valve, paratype, no. 988; fig. 13, left valve, paratype no. 987; fig. *14*, complete specimen, paratype, no. 989. (p. 209)

and possesses a much greater number of minute ribs in the ventral half.

CYTHERETTA PAUCIPUNCTATA
(Ulrich and Bassler)
Plate 39, figs. 1, 2; text figs. 3, 4

Cythere paucipunctata ULRICH & BASSLER, Maryland Geol. Surv., Mio. Rept., 1904, p. 105, pl. 38, figs. 7–9.
Cythere tuomeyi ULRICH & BASSLER, Maryland Geol. Surv. Mio. Rept., 1904, pp. 105, 106, pl. 38, figs. 4–6.

Carapace elliptical, greatest height slightly behind the center. Dorsal margin straight, slightly convex in middle; ventral margin tumid, slightly overhanging. Anterior end broadly rounded, sharper ventrally than dorsally. Posterior end subacute, slightly produced, with greatest curvature slightly above mid-height, denticulate, with five marginal spines. Surface smooth except on most convex portion slightly behind center where there are three rows of large, rounded, sometimes not well-defined pits, three to five in each row. Much smaller pits scattered all over surface, coincide with the normal pore canals. As viewed from inside, valves moderately deep, translucent so that external ornamentation is visible. Marginal areas broad, broadest anteriorly. Radial pore canals numerous, long, branching, occur in bunches of two or three, more numerous along anterior than posterior and ventral margins where they are scanty. Hinge of left valve with anterior and posterior sockets flanked with the tooth-like projections of dorsal margin connected by a narrow bar-like ridge. Hinge in right valve consists of a bicusped, oblong anterior tooth, a postjacent socket, and a posterior conical, sharp, somewhat smaller tooth connected by a deep, narrow groove.

Dimensions of paratype no. 969, a left valve: length 1.030 mm.; height .608 mm.; paratype no. 970, a right valve of another individual: length .997 mm.; height .574 mm. All figured specimens are from the Calvert Miocene of Maryland, locality no. 46, the only locality from which this species has been reported.

CYTHERETTA ULRICHI Puri, n. name
Plate 39, fig. 3; text figs. 5, 6, 7

Cythere plebeia ULRICH & BASSLER (non *Cythere plebeia* Reuss of JONES, 1860), Md. Geol. Surv., Mio. Rept., 1904, pp. 102, 103, pl. 35, figs. 20–29.
Cythere plebeia? var. *capax* ULRICH & BASSLER, Md. Geol. Surv. Mio. Rept., 1904, p. 103, pl. 35, figs. 30–33.
Cythere porcella ULRICH & BASSLER, Md. Geol. Surv. Mio. Rept., 1904, pp. 106, 107; pl. 36, figs. 26–33.
Cytheretta plebia (sic) SWAIN, Bull. State of Md., Cret. and Tert. Subsurface Rept., 1948, p. 212, pl. 13, figs. 3, 4.

Carapace elongate, outline approximately a parallelogram. Valves moderately and evenly convex, greatest height slightly posterior to center. Dorsal margin straight, slightly convex; ventral margin straight,

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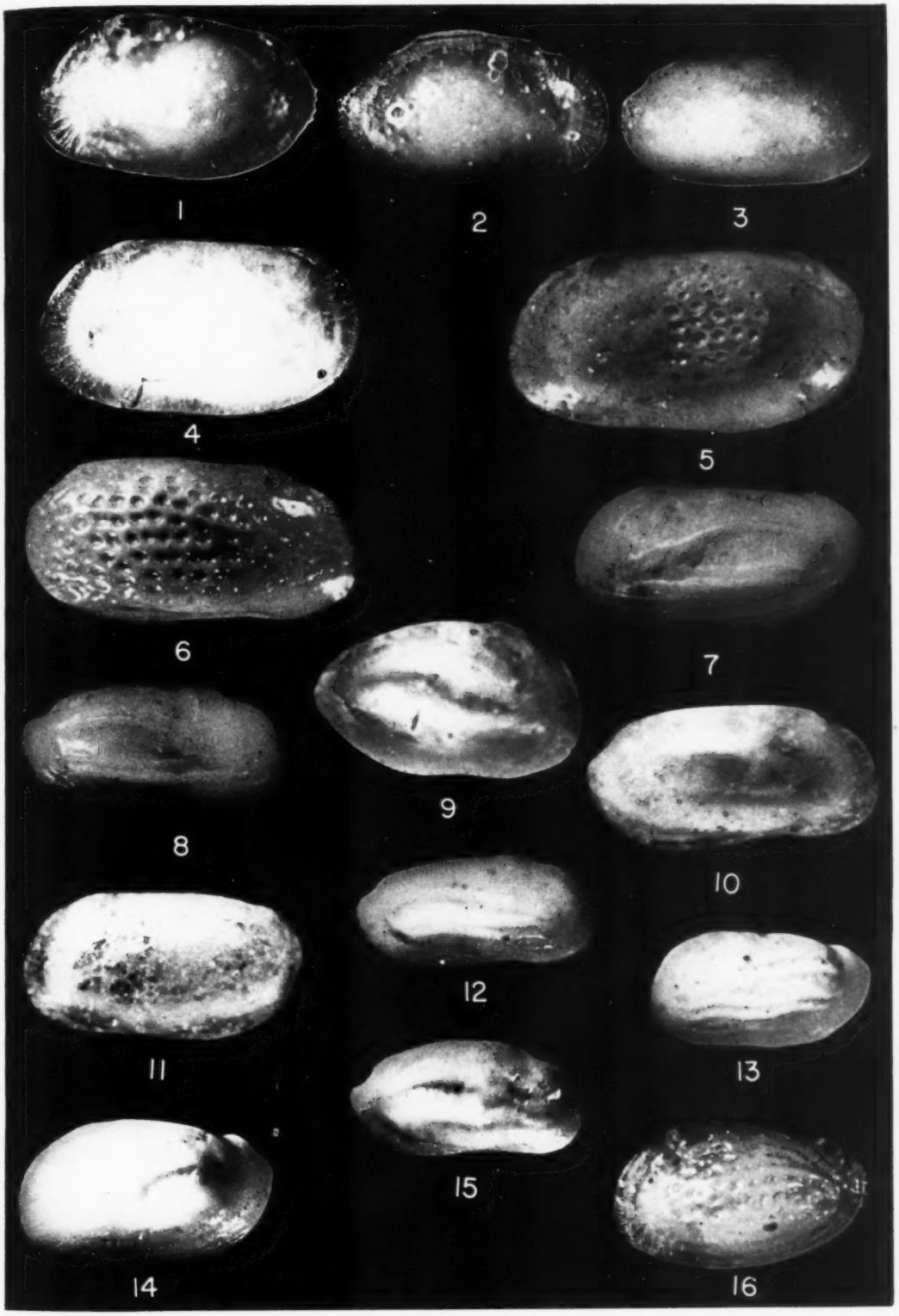
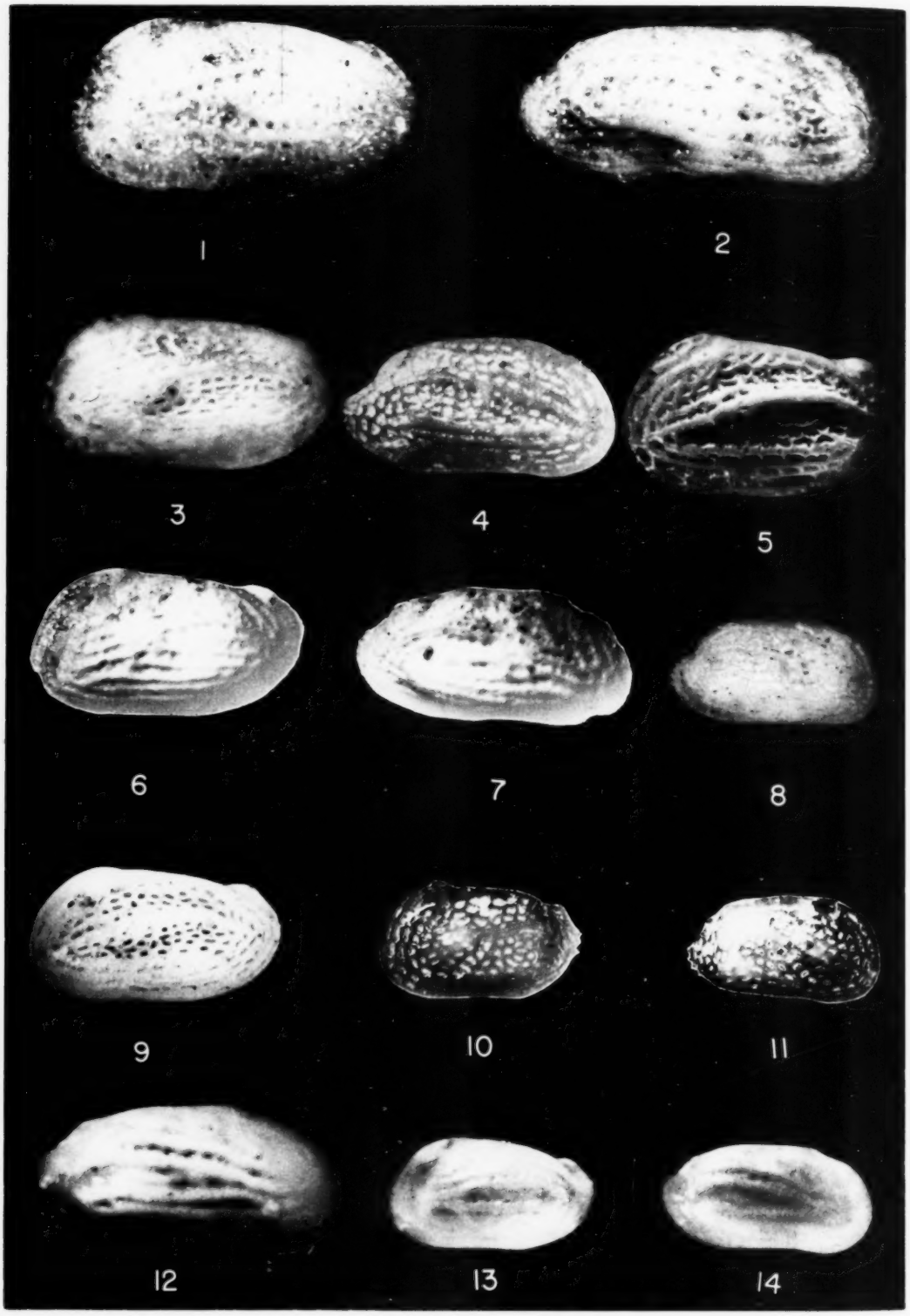
EXPLANATION OF PLATE 39

All figures ×45. Specimen numbers refer to the Henry V. Howe type collection at the Louisiana State University.

FIGS. *1, 2*—*Cytheretta paucipunctata* (Ulrich and Bassler), locality no. 46. Fig. *1*, left valve, paratype, no. 969; fig. *2*, right valve, paratype, no. 970. (p. 204)
3—*Cytheretta ulrichi* Puri, n. name, right valve, paratype no. 971, locality no. 45. (p. 204)
4—*Cytheretta spencerensis* Smith, left valve, cotype, no. 2872, locality no. 47. (p. 205)
5, 6—*Cytheretta burnsi* (Ulrich and Bassler), locality no. 12. Fig. *5*, left valve, paratype, no. 974; fig. *6*, right valve, paratype, no. 975. (p. 205)
7, 8—*Cytheretta sahnii* Puri, n. sp., locality no. 34. Fig. *7*, left valve, holotype, no. 976; fig. *8*, right valve, paratype, no. 977. (p. 206)
9—*Cytheretta inaequivalvis* (Ulrich and Bassler), right valve of complete specimen, paratype, no. 978, locality no. 38. (p. 207)
10, 11—*Cytheretta bassleri* Howe, locality no. 3. Fig. *10*, right valve, plesiotype, no. 979; fig. *11*, left valve, plesiotype, no. 980. (p. 208)
12, 13—*Cytheretta dalli* Smith, locality no. 28. Fig. *12*, right valve, cotype, no. 2861; fig. *13*, left valve, cotype, no. 2863. (p. 208)
14, 15—*Cytheretta okaloosaensis* Smith, locality no. 28. Fig. *14*, left valve, cotype, no. 2870; fig. *15*, right valve, cotype, no. 2871. (p. 208)
16—*Cytheretta alexanderi* Howe and Chambers, left valve, plesiotype, no. 981, locality no. 49. (p. 208)



Puri, North American Cytheretta and Paracytheretta



Puri, North American Cytheretta and Paracytheretta

slightly concave just anterior to middle, but generally parallel to dorsum. Anterior end blunt, obliquely rounded, more so in upper half. Posterior end narrow, obliquely rounded in ventral half, oblique above. Surface smooth with shallow, rounded, scattered pits having no regular pattern except that they tend to occur in pairs. As viewed from inside, valves moderately deep, thick. Marginal areas very broad. Line of concrescence coincides with inner margin, forms the characteristic S-line of genus. Radial pore canals fairly numerous, straight, slender, with tendency to occur in pairs, more numerous along anterior than posterior or ventral margins, where they are scanty. Hinge in left valve consists of anterior and posterior sockets flanked by tooth-like projections of dorsal margin connected by a bar-like ridge. Hinge in right valve consists of an anterior conical tooth, almost vertical in front and sloping steeply behind, a postjacent socket and a somewhat smaller posterior conical tooth connected by a deep, narrow groove.

Dimensions of paratype no. 971, a right valve: length .952 mm; height .490 mm.; paratype no. 972, a left valve of another individual: length .980 mm.; height .540 mm. All the figured specimens came from the Calvert Miocene of Maryland, locality no. 45.

This species has not been reported previously from the Miocene of the Gulf Coastal Plain.

CYTHERETTA SPENCERENSIS Smith
Plate 39, fig. 4

Cytheretta spencerensis SMITH, Amer. Assoc. Pet. Geol. Bull., vol. 25, 1941, pp. 282, 283, pl. 1, figs. 4, 5, 6, 8.

This species was originally described by Smith from the *Yoldia* zone of the Choctawhatchee at locality no. 47. It is a good marker for this zone and the upper part of the Shoal River. Smith's cotype no. 2872, a left valve, is refigured.

Dimensions of cotype 2872, a left valve; length 1.150 mm., height .630 mm.

CYTHERETTA BURNSI (Ulrich and Bassler)
Plate 39, figs. 5, 6

Cythere burnsi ULRICH & BASSLER, Maryland Geol. Surv., Mio. Rept., 1904, p. 103, pl. 36, figs. 34–39.

Cythere nitidula ULRICH & BASSLER, Maryland Geol. Surv., Mio. Rept., 1904, pp. 107, 108, pl. 36, figs. 21–23.

Cytheretta burnsi HOWE ET AL., Florida Geol. Surv. Bull. 13, 1935, p. 33, pl. 2, figs. 12–14, 17, 20; pl. 4, figs. 14, 21.

This species, originally described from the Calvert Miocene of Maryland, is present in the middle Miocene *Arca* zone of the Choctawhatchee formation of Florida at localities 12, 14 and 16 and in the Duplin marl, localities 9, 18, 20, 24 and 41.

The figured specimens came from the *Arca* zone locality no. 12.

Dimension of the paratype no. 974, a left valve: length 1.267 mm.; height .625 mm.;

EXPLANATION OF PLATE 40

All figures ×45. Specimen numbers refer to the Henry V. Howe collection at the Louisiana State University.

FIGS. *1, 2*—*Paracytheretta gardneri* (Smith), locality 36. Fig. *1*, left valve, topotype, no. 982; fig. *2*, right valve, topotype, no. 983. (p. 209)

3, 4, 5—*Paracytheretta karlana* (Howe and Pyeatt). Fig. *3*, left valve, plesiotype, no. 984; fig. *4*, right valve, plesiotype, no. 985, both from locality no. 38; fig. *5*, left valve, plesiotype, no. 986, locality no. 17. (p. 209)

6, 7—*Paracytheretta howei* (Swain), locality no. 44. Fig. *6*, left valve, paratype, no. 987; fig. *7*, right valve, paratype, no. 988. (p. 209)

8, 9—*Paracytheretta choctawhatcheensis* (Howe and Taylor). Fig. *8*, right valve, paratype, no. 990, locality no. 3; fig. *9*, left valve, paratype, no. 991, locality no. 1. (p. 210)

10, 11—*Paracytheretta daniana* (Brady), locality no. 51. Fig. *10*, left valve, paratype, no. 992; fig. *11*, right valve, paratype, no. 993. (p. 210)

12, 13, 14—*Paracytheretta calhounensis* (Smith). Fig. *12*, right valve, paratype, no. 995, locality no. 1; fig. *13*, left valve, paratype, no. 996; fig. *14*, right valve, paratype, no. 997, both from locality no. 33. (p. 211)

paratype no. 975, a right valve of another individual: length 1.183.; height .557 mm.

CYTHERETTA SAHNII Puri, n. sp.
Plate 39, figs. 7, 8; text figs. 1, 2

Carapace elongate ovate, greatest height posterior. Dorsal margin straight, slightly convex in middle. Ventral margin slightly concave immediately in front of center. Valves inequal, differently shaped. Anterior end of right valve obliquely rounded; posterior subacute just above middle. A well-marked notch occurs at either end of dorsal margin for accommodation of cardinal projections of left valve. Anterior end of left valve rounded; posterior less acute than right. Surface ornamented near center by two fine, sinuous, obliquely longitudinal ribs separated by well-marked depression. Both ribs start at point of greatest height, dorsal one more conspicuous, parallels dorsal margin to middle, then sharply bends downwards. Ventral rib similarly oblique towards anterior end where it gradually loses its identity. Surface below ventral rib completely covered with longitudinal subparallel striations. As viewed from inside, valves moderately deep, fairly thick so that radial pore canals are not visible. Inner margin forms S-shape characteristic of genus. Hinge in right valve consists of a strong, conical, anterior tooth, a postjacent socket, a somewhat smaller oval posterior tooth, connected by a deep groove below dorsal margin. Hinge in left valve consists of anterior and posterior sockets flanked by tooth-like projec-

TABLE I.—CORRELATION OF MIOCENE SECTION OF WESTERN FLORIDA WITH THE SECTION USED IN THIS ARTICLE

Standard Section*					Section used in this article
MIOCENE	UPPER	Choctawhatchee formation		*Cancellaria zone*	*Cancellaria* zone†
				Ecphora zone	*Ecphora* zone†
	MIDDLE			*Arca* zone	Perimeter's farm beds
				Yoldia zone	*Arca* zone
					Yoldia zone
		ALUM BLUFF GROUP	Shoal River formation	*Cardium* bed	Lower beds at Spence farm
					Cardium bed
				Middle zone	Type Shoal River
				Type zone	Godwin Bridge beds
			Oak Grove sand	Transition zone	Upper Oak Grove
				Type zone	Type Oak Grove
	LOWER		Chipola formation	Chipola	Chipola
		Tampa formation		Tampa	Tampa

* Modified after Cushman and Ponton (1932). Most of the collections were made from localities described by them.
† Duplin marl of the Carolinas.

tions of dorsal margin, connected by a raised bar-like ridge formed by dorsal margin.

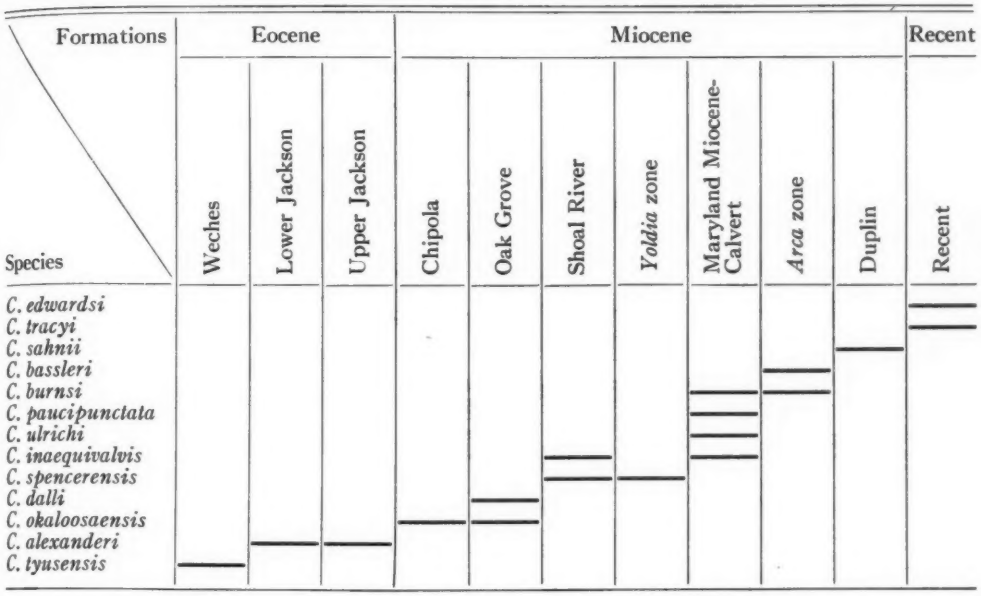
Dimensions of holotype no. 976, a left valve: length .997 mm.; height .507 mm.; paratype no. 977, a right valve of a different individual: length .912 mm.; height .473 mm.

land Geol. Surv., Mio. Rept., 1904, pp. 101, 102, pl. 35, figs. 15–17.

Cytheretta inaequivalvis SWAIN, Bull. State of Maryland, Cret. and Tert. Subsurface Rept., 1948, p. 213, pl. 13, fig. 5.

Carapace elongate, outline approaching a triangle. Valves very unequal, unevenly

RANGE CHART 1.—RANGE OF *Cytheretta* IN AMERICA



This species is described from the *Ecphora* zone of the Duplin marl formation of Florida, locality no. 34. It has also been found at the Duplin marl localities 4, 7, 8, 9, 10, 18, 23, 31, 34, 35, 37, 41 and Choctawhatchee locality no. 42.

This species is very similar to *C. bassleri* but differs in having a well marked depression between the two central sinuous ribs and being entirely striated longitudinally below. Also the right valve is proportionately more elongate. This species resembles *C. okaloosaensis* somewhat but differs in having its ventral portion completely striated longitudinally.

CYTHERETTA INAEQUIVALVIS
(Ulrich and Bassler)
Plate 39, fig. 9

Cythere inaequivalvis ULRICH & BASSLER, Mary-

convex, most prominent point postventrally just beneath subcentral furrow. Dorsal margin slightly convex, ventral margin slightly concave. Anterior end broadly, obliquely rounded, most so in upper half. Posterior end narrow, slightly rounded in upper half, oblique below, producing more or less triangular shape. Right valve smaller than left, differently shaped. Surface smooth except for two strong longitudinal ridges with subcentral furrow in which some obscure pits are scattered. Hingement strong, normal for genus.

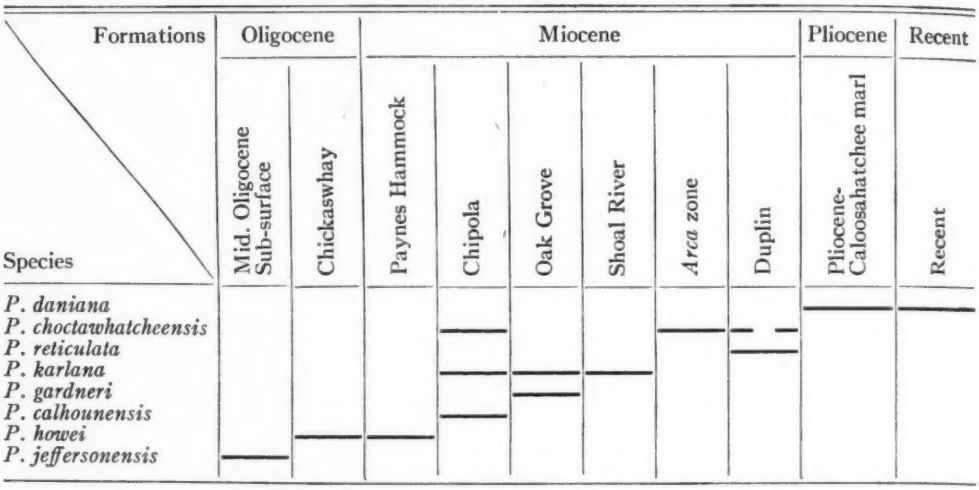
Dimensions of the paratype no. 978, a complete specimen: length 1.014 mm.; height .608 mm.

The figured specimen came from the Shoal River locality no. 38. The species is also represented at Plum Point localities 45 and 46.

This species was originally described from the Calvert Miocene of Maryland. The Florida specimens are more or less triangular but the type specimens were described as having an outline approaching a parallelogram. The Florida specimens also show comparatively stronger longitudinal ridges and consequently a deeper subcentral furrow. the type Oak Grove at locality no. 28. It seems to be characteristic of the Oak Grove since it has not been found in higher or lower beds. Smith's cotypes nos. 2861 and 2863 are refigured.

Dimensions of the cotype no. 2861, a right valve: length .860 mm.; height .390 mm.; cotype no. 2863, a left valve of another individual: length .830 mm.; height .430 mm.

RANGE CHART 2.—RANGE OF *Paracytheretta* IN AMERICA



CYTHERETTA BASSLERI Howe
Plate 39, figs. 10, 11

Cytheretta bassleri Howe, HOWE ET AL., Fla. Geol. Surv. Bull. 13, 1935, p. 32, pl. 3, figs. 21, 22.

This species was originally described from *Arca* zone of the middle Miocene of the Choctawhatchee formation of Florida. It is present in the *Arca* zone at localities 3, 11, 13, 15 and 16. The figured specimens came from no. 3.

Dimensions of the plesiotype no. 979, a right valve: length 1.115 mm.; height .540 mm.; plesiotype no. 980, a left valve of a different individual: length 1.089 mm.; height .540 mm.

CYTHERETTA DALLI Smith
Plate 39, figs. 12, 13

Cytheretta dalli SMITH, Amer. Assoc. Pet. Geol., Bull., vol. 25, 1941, p. 282, pl. 1, figs. 2, 6, 8; pl. 2, figs. 3, 7, 13.

This species was originally described from

CYTHERETTA OKALOOSAENSIS Smith
Plate 39, figs. 14, 15

Cytheretta okaloosaensis SMITH, Amer. Assoc. Pet. Geol., Bull., vol. 25, 1941, p. 283, pl. 1, fig. 1 3, 9, 10, 16, pl. 2, figs. 1, 7, 9, 11, 14.

This species was originally described from the type Oak Grove at locality no. 28. It has also been reported from the lower Miocene Chipola formation. Smith's cotypes nos. 2870 and 2871 are refigured.

Dimensions of cotype no. 2870, a left valve: length .950 mm.; height .450 mm.; cotype no. 2871, a right valve of another individual: length .870 mm.; height .460 mm.

CYTHERETTA ALEXANDERI Howe and Chambers
Plate 39, fig. 16

Cytheretta alexanderi HOWE & CHAMBERS, Louisiana Geol. Surv. Bull. 5, 1935, pp. 45, 46, pl. 5, figs. 17–21; pl. 6, figs. 27, 28.
Cythereis (?) *catahoulana* HOWE & PYEATT,

HOWE & CHAMBERS, Louisiana Geol. Surv. Bull. 5, 1935, pp. 25, 26, pl. 3, fig. 7; pl. 6, figs. 25, 26.
Cythereis (?) catahoulana var. pyeatti HOWE & CHAMBERS, Louisiana Geol. Surv. Bull. 5, 1935, pp. 26, 27, pl. 3, figs. 20, 21.
Cytheretta alexanderi, BERGQUIST, Mississippi Geol. Surv. Bull. 49, 1942, p. 109, pl. 11, fig. 20.
Cytheretta alexanderi, MONSOUR, Amer. Assoc. Pet. Geol. Bull., vol. 21, 1937, pp. 90, 95.
Cytheretta alexanderi, GARRETT, Journ. Paleontology, vol. 10, 1936, p. 786.
Cytheretta alexanderi, BLAKE, Journ. Paleontology, vol. 24, 1950, p. 177, pl. 30, figs. 1–3.

This species was originally described from the Jacksonian Eocene Creole Bluff on the Red River at Montgomery, Louisiana. *Cythereis (?) catahoulana* and *Cythereis (?) catahoulana pyeatti* were described from the upper Jacksonian Danville Landing, locality no. 50, and lower Jacksonian Grand View Bluff, locality no. 48, respectively. Examination of the type specimens has shown that these forms are young stages of *C. alexanderi*.

Dimensions of the plesiotype no. 981, a left valve: length .901 mm.; height .523 mm.

The figured specimen came from the lower Jacksonian Caney Point member, locality no. 49.

Genus PARACYTHERETTA Triebel

Paracytheretta TRIEBEL, 1941, p. 388; VAN DEN BOLD, 1946, p. 28.

Genotype: Paracytheretta reticosa TRIEBEL, 1941, p. 389, pl. 15, figs. 165–168.

Carapace elongate ovate. Left valve larger than right, overlaps right valve all along ventral margin and at both cardinal angles, especially the anterior. At posterior end there is a cylindrically rounded, laterally compressed process. The surface ornamented with three strong longitudinal ribs, a reticulate network and as a rule a distinct marginal rim. Hinge similar to *Cytheretta*.

Range: Cretaceous (?) to Recent.

PARACYTHERETTA GARDNERI (Smith)
Plate 40, figs. 1, 2

Cytheretta gardneri SMITH, Amer. Assoc. Pet. Geol. Bull., vol. 25, 1941, pp. 281, 282, pl. 1, figs. 4, 5; pl. 2, figs. 16, 17.

This species is a good marker for the middle Miocene Oak Grove formation of Florida. It occurs rarely at locality 36.

Dimensions of the topotype no. 982, a left valve: length 1.064 mm.; height .557; topotype no. 983, a right valve of another individual: length 1.115 mm.; height .517 mm.

The figured specimens came from the Oak Grove locality 36.

PARACYTHERETTA KARLANA
(Howe and Pyeatt)
Plate 40, figs. 3–5; text fig. 8

Cytheretta karlana HOWE and PYEATT, Howe et al., Fla. Geol. Surv. Bull. 13, 1935, pp. 34, 35, pl. 1, figs. 30, 34; pl. 3, figs. 3, 4.
Cytheretta karlana SMITH, Bull. Amer. Assoc. Pet. Geol. Bull., vol. 25, 1941, p. 279.
Cytheretta karlana VAN DEN BOLD, 1946, p. 106, pl. 19, fig. 18.

This species was described from the Chipola Miocene, locality no. 32. The present study has shown that it is also present in the middle Miocene Oak Grove and Shoal River formations.

Dimensions of plesiotype no. 984, a left valve: length 1.098 mm.; height .557 mm.; plesiotype no. 985, a right valve of another individual: length .962 mm.; height .523 mm.; plesiotype no. 986, a left valve: length .963 mm.; height .557 mm.

The figured specimens came from the middle Miocene Shoal River locality no. 38 and the Chipola locality no. 17.

This species is common in the Chipola Miocene where it occurs at localities 1, 2, 17, 21, 22, 27, 29, 32 and 33. It was also found at the Oak Grove locality no. 36 and the Shoal River locality no. 38.

PARACYTHERETTA HOWEI (Swain)
Plate 40, figs. 6, 7; text figs. 12–14

Cytheretta howei SWAIN, Journ. Paleontology, vol. 20, 1946, p. 380, pl. 54, fig. 12; pl. 55, fig. 8a–c.

Carapace oblong ovate, highest posteriorly. Dorsal margin nearly straight, slightly convex in middle; ventral margin slightly concave. Anterior end blunt, broadly rounded; posterior end subacute, somewhat produced, terminating above the middle. Surface reticulate, ornamented with about fifteen unevenly rounded, moderately pro-

jecting, longitudinal ribs parallel to dorsal and ventral margins for a short distance on upper and lower portion of carapace but oblique in central portion. Rows of subquadrate pits between ribs complete reticulate pattern. As viewed from inside, valves moderately deep, thick, so that external ornamentation is not visible. Marginal areas broad, most so anteriorly. Pore canals obscure because of thickness of valves. Hinge in right valve consists of large oblong anterior tooth, a postjacent socket leading to a well marked groove below bar-like ventral margin. Posterior tooth somewhat smaller than anterior. Hinge in left valve normal for genus.

This species, originally described from the subsurface Oligocene of Florida, is also present in the lower Miocene Paynes Hammock of Mississippi, locality no. 44.

Dimensions of the paratype no. 987, a left valve: length .980 mm.; height .523 mm.; paratype no. 988, a right valve of another individual: length .997 mm.; height .490 mm.; paratype no. 989, a complete specimen: length 1.030 mm.; height .523 mm.

All figured specimens came from the lower Miocene Paynes Hammock formation of Mississippi, locality no. 44.

PARACYTHERETTA CHOCTAWHATCHEENSIS (Howe and Taylor)
Plate 40, figs. 8, 9

Cytheretta karlana choctawhatcheensis HOWE and TAYLOR, Howe et al., Florida Geol. Surv. Bull. No. 13, 1935, p. 35, pl. 1, fig. 28, 29, 33.
Cytheretta karlana choctawhatcheensis VAN DEN BOLD, 1946, p. 106, pl. 10, figs. 24a–d.

Carapace elongate ovate, fat, stout. Greatest height and thickness posterior. Dorsal margin straight, ventral margin slightly concave. Anterior end broadly rounded, posterior subacute. Surface reticulate, with three pronounced ridges seeming to join on posterior slope, diverging anteriorly, dying out on anterior slope. Dorsal ridge least prominent, between it and central ridge are four parallel rows of subquadrangular pits, most prominent anteriorly. Between central and ventral ridges, five parallel rows of pits and, slightly in front of center, a well marked depression. A row of shallow, subrectangular pits present in middle of ventral ridge. As viewed from inside, valves fairly deep, smooth, so thick that radial pore canals are not visible. Hinge heavy; in right valve consists of an anterior knob-like tooth, a postjacent socket leading to a shallow groove below bar-like ridge of dorsal margin and knob-like posterior tooth at cardinal angle. In left valve, hinge consists of anterior and posterior sockets flanked by the tooth-like projections of dorsal margin, connected by a bar-like ridge of dorsal margin.

Dimensions of the paratype no. 990, a right valve from the *Arca* zone, locality no. 3: length .777 mm.; height .442 mm.; paratype no. 991, a left valve from the Chipola, locality no. 1: length .912 mm.; height .490 mm.

The figured specimens came from the middle Miocene Chipola, locality no. 1, and the *Arca* zone of the Choctawhatchee, locality no. 3. This species also occurs in the *Arca* zone at locality no. 16 and questionably at the Duplin localities 19, 20, 31, 34 and 35.

PARACYTHERETTA DANIANA (Brady)
Plate 40, figs. 10, 11; text fig. 11

Cythere daniana BRADY in Les Fonds de la Mer, vol. 1, 1869, p. 124, pl. 14, figs. 13, 14.

Carapace elongate ovate, slightly higher in front. Dorsal margin subconvex, ventral margin subconcave. Anterior end rounded, somewhat produced ventrally; posterior end acute, denticulate with six marginal spines. Surface reticulate; ornamentation consists of subequal, subparallel, longitudinal ribs with subquadrate pits between them. Uppermost rib centrally located, starts on posterior slope, becomes slightly thicker before gradually merging with anterior slope. Second prominent rib ventral, also starts on crest of posterior slope, extends parallel to first toward anterior slope. A third rather inconspicuous rib is obscure on ventral slope. Four rows of subquadrate pits occur between two main ribs. As viewed from inside, valves moderately deep, smooth, so thick that radial pore canals are not visible. Hinge in right valve consists of an anterior knob-like tooth, a postjacent socket, a groove below dorsal margin and a smaller

but higher posterior tooth at the cardinal angle. Hinge of left valve normal for genus.

Dimensions of the paratype no. 992, a left valve: length .726 mm.; height .405 mm.; paratype no. 993, a right valve of a different individual: length .629 mm.; height .388 mm.; paratype no. 994, a right valve: length .895 mm.; height .473 mm.

The figured specimens are Recent from Port au Prince locality no. 52, and from the Pliocene Caloosahatchee marl, locality no. 51, where this species is very common.

PARACYTHERETTA CALHOUNENSIS (Smith)

Plate 40, figs. 12, 13, 14; text figs. 9, 10

Cytheretta calhounensis SMITH, Bull. Amer. Assoc. Pet. Geol., vol. 25, 1941, p. 283, pl. 1, figs. 12, 13; pl. 2, figs. 2, 15.

Carapace elongate ovate, highest posteriorly. Dorsal margin slightly convex, ventral margin slightly concave. Anterior end broadly rounded, posterior subacute, terminating somewhat above middle. Surface reticulate, with four or five unevenly spaced, subequal and subparallel longitudinal ribs between which lies a row of rectangular pits. As viewed from inside, valves deep, moderately thick. Marginal area broad. inner margin coincides with line of concrescence, forms characteristic S-line. In right valve, outer margin coincides with periphery posteriorly. Hinge of right valve consists of a larger anterior tooth, a postjacent socket leading to a faint groove below bar-like dorsal margin and a somewhat smaller oblong posterior tooth. Hinge of the left valve consists of anterior and posterior sockets flanked by tooth-like projections of dorsal margin, connected by a narrow, bar-like ridge. Pore canals few, long, not very conspicuous because of thick carapace.

Dimensions of paratype no. 995, a right valve from locality no. 1: length .794 mm.; height .405 mm.; paratype no. 996, a left valve from locality no. 33: length .726 mm.; height .402 mm.; paratype no. 997, a right valve of another individual from locality no. 33: length .742 mm.; height .388 mm.

The figured specimens came from the lower Miocene Chipola localities 1 and 33, where this species is common. It also occurs at Chipola localities 2, 5, 6, 17, 21, 22, 25, 26 and 30. This species seems to be restricted to the Chipola formation, as it has not been found in other zones.

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A CLASSIFICATION OF THE CRETACEOUS AMMONITES

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INTRODUCTION

DR. W. J. ARKELL has recently published (1950) "A Classification of the Jurassic Ammonites," primarily in connection with the forthcoming Treatise on Invertebrate Paleontology, sponsored in America by the Geological Society of America, the Paleontological Society and the Society of Economic Paleontologists and Mineralogists.

The present paper is the Cretaceous continuation of Arkell's and is published with the same intention as his, to elicit constructive criticism in advance of the completion of the section of the Treatise on Mesozoic Ammonoidea.

In general Arkell's remarks on taxonomic scale and categories and the bases of classification apply to the present paper and there is no point in repeating them here.

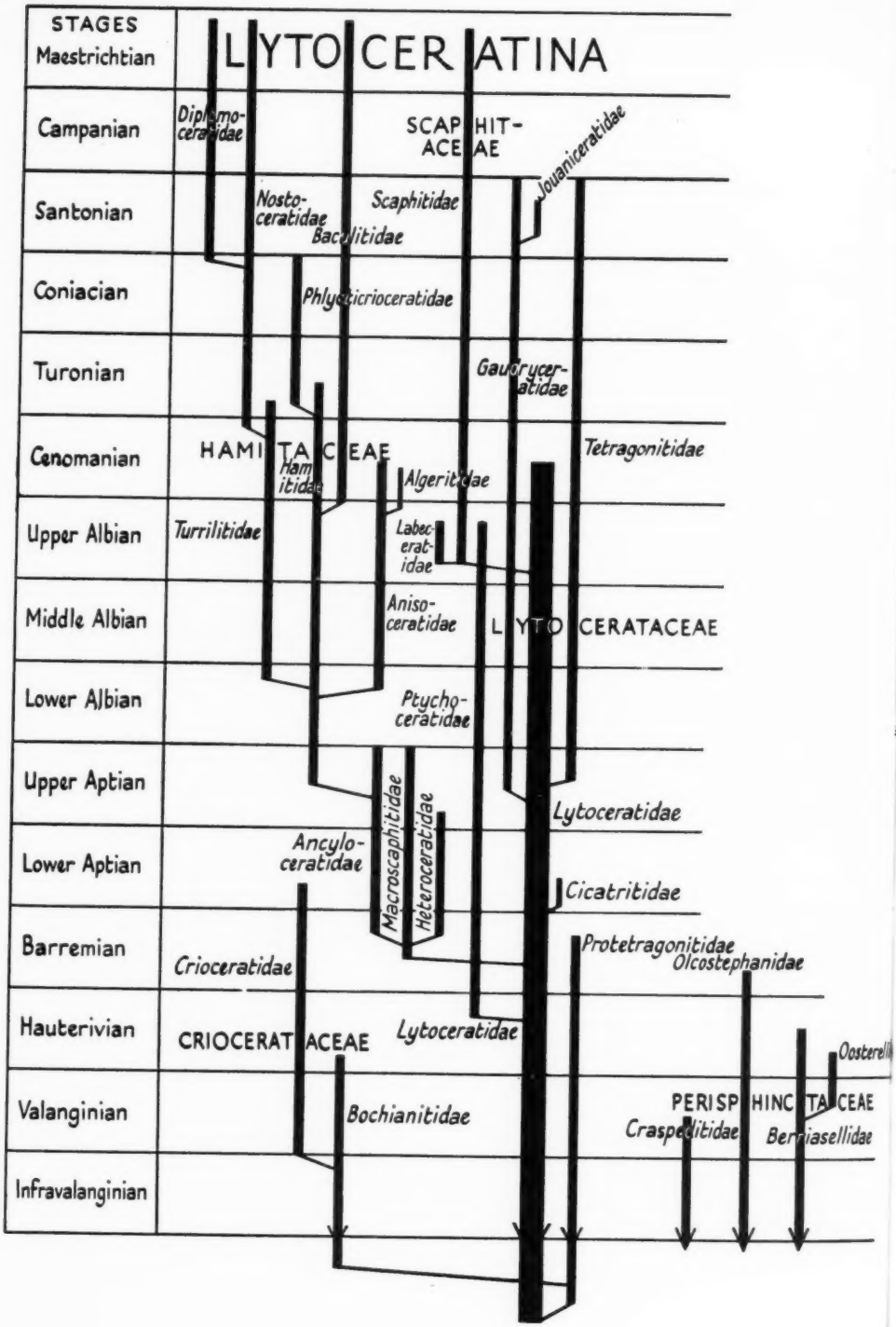
With regard to family names, it has been suggested by the Editor-in-Chief of the Treatise on Invertebrate Paleontology that, despite the absence of a decision on the subject by the International Committee on Zoological Nomenclature, names originally published with endings other than *-idae* or *-inae* should be eligible for consideration and if adopted should retain the name of the author and date of the original publication. This suggestion is accepted here and as a result a number of family and subfamily names are adopted from H. Douvillé (1911), although they were published with endings *-idês* or *-inês*.

The 1948 Zoological Congress did not reach a decision on the procedure to be adopted when two or more families are united on taxonomic grounds. Pending a decision in 1953, the author adopts what seems to him the only procedure likely to lead to stability and objectivity, namely to adopt for the united family the earliest published family or subfamily name whose type genus is included in the united family. The results of this procedure may be temporarily inconvenient (e.g. Mojsisovicziinae Hyatt 1903 replaces Dipoloceratinae Spath 1921), but the author believes that in the long term this is the only satisfactory solution

I would point out in amplification of the introductory remarks of Arkell's paper that the implications of the dimension of time in a classification of this sort must be appreciated. Whereas in neozoology diagnosis at all levels of a classification is practicable in the manner of an "artificial key" and the classification itself is usually static, in paleozoology the classification must to some extent be dynamic with the consequence that at the higher levels diagnosis in purely morphological terms is often virtually impossible; the concept of time and derivation must usually be brought in to define superfamilies and higher units. As Arkell points out, this fact is likely to be of little or no practical importance to the field geologist or stratigrapher.

Consideration of the diagrams in figures 1 and 2 will show that the families and superfamilies are treated as being of two main categories. First are those with a presumed single, or virtually single, point of origin in a previous family. The second includes those comprising several strands derived successively from another family as members of that family successively took on a particular series of new characters, the potentiality for which was presumably latent in the whole or a large part of the family. The type of family or superfamily that is *not* used is that in which stocks derived at the same or different times from *different* families are united because of their close morphological similarity.

It should be emphasized most strongly that the diagram in figure 1 represents only the present state of our knowledge and an over-simplification of it at that. There are several possible places for most of the families shown, and those selected are merely the ones regarded by the author as most probable. In addition there are many


STAGES
Maestrichtian
Campanian
Santonian
Coniacian
Turonian
Cenomanian
Upper Albian
Middle Albian
Lower Albian
Upper Aptian
Lower Aptian
Barremian
Hauterivian
Valanginian
Infravalanginian
LYTOCERATINA
Diplomoceratidae
SCAPHITACEAE
Jouaniceratidae
Nostoceratidae
Scaphitidae
Baculitidae
Phylloicrioceratidae
Gaudryceratidae
HAMITACEAE
Hamitidae
Algeritidae
Tetragonitidae
Turrilitidae
Labeceratidae
Anisoceratidae
LYTOCERATACEAE
Ptychoceratidae
Lytoceratidae
Ancyloceratidae
Macroscaphitidae
Heteroceratidae
Cicatritidae
Protetragonitidae
Crioceratidae
Olcostephanidae
CRIOCERATACEAE
Lytoceratidae
Oosterellidae
Bochianitidae
PERISPHINCTACEAE
Crassitidae
Berriasellidae

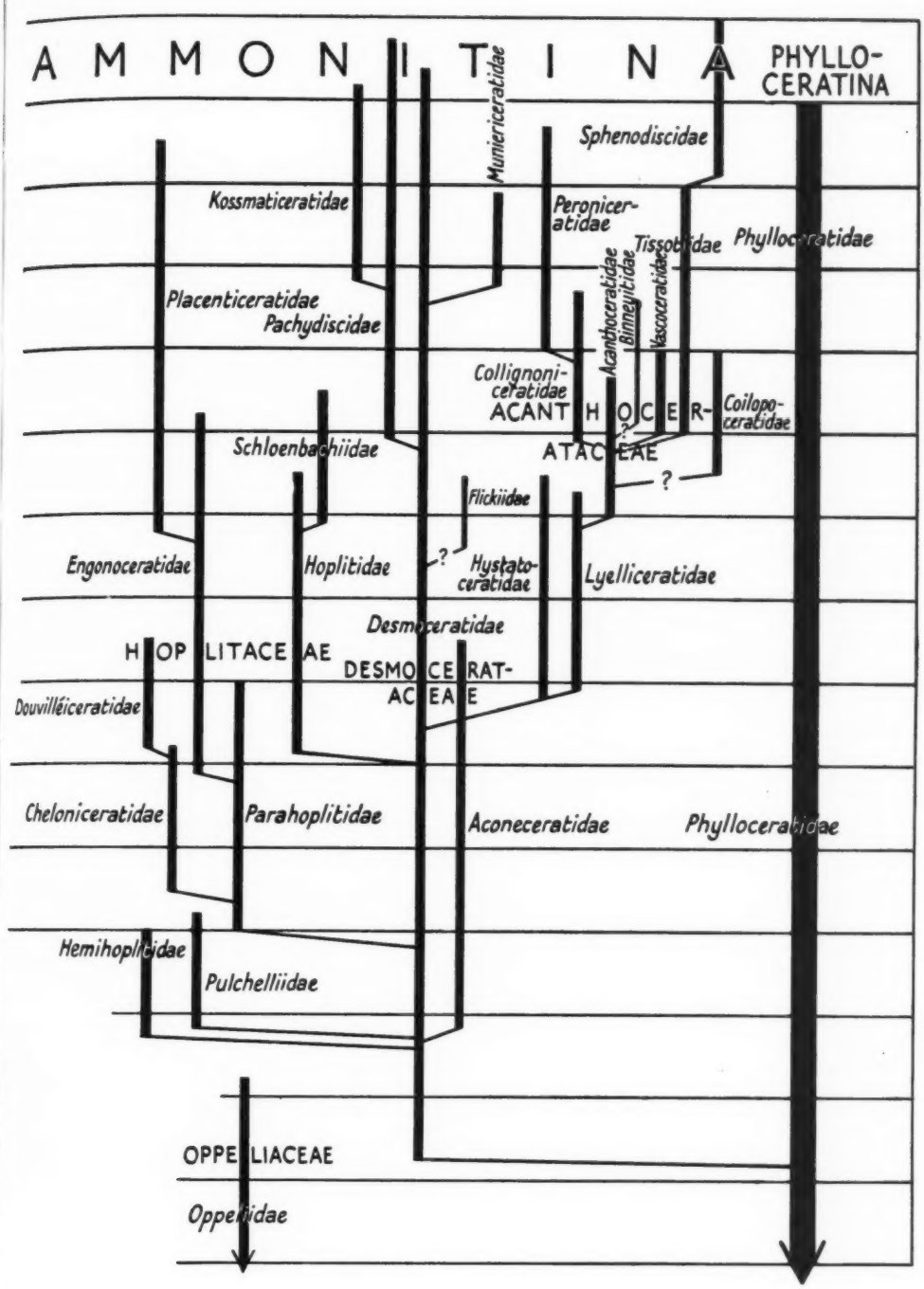

AMMONITINA
PHYLLOCERATINA
Muniericeratidae
Sphenodiscidae
Kossmaticeratidae
Peroniceratidae
Tissotiidae
Phylloceratidae
Placenticeratidae
Pachydiscidae
Acanthoceratidae
Binneyitidae
Vascoceratidae
Collignoniceratidae
ACANTHOCERATACEAE
Coilopoceratidae
Schloenbachiidae
Flickiidae
Engonoceratidae
Hoplitidae
Hystatoceratidae
Lyelliceratidae
Desmoceratidae
HOPLITACEAE
DESMOCERATACEAE
Douvilleiceratidae
Cheloniceratidae
Parahoplitidae
Aconeceratidae
Phylloceratidae
Hemihoplitidae
Pulchelliidae
OPPELIACEAE
Oppeliidae

FIG. 1

known but undescribed forms which do not yet fit into the scheme. Every year demonstrates also the great number of new faunas awaiting discovery and description. For historical reasons any scheme of classification is bound to be overweighted in the emphasis on the faunas of those parts of the world that happen to have been well explored.

The author is indebted to Dr. W. J. Arkell for encouragement and advice and to Dr. Spath for many valuable discussions and for patiently enduring and answering a very large number of questions.

CRETACEOUS AMMONITES

In the Cretaceous as in the Jurassic, the Phylloceratina are a very homogeneous stock, and in the Cretaceous, no subdivision above subfamily level is required. On the other hand the Lytoceratina gave rise in this epoch to a succession of offshoots, some short and some long lived, many characterized by divergence from the normal mode of coiling. The classification of these very varied and often markedly distinct forms has always presented some difficulty. In view of the strong tendency in many Cretaceous lytoceratid stocks to aberrant coiling, it seems that all these "heteromorphic" forms that are closely linked with members of the suborder Lytoceratina should be grouped with them in the same suborder, but that on a lower level they should be arranged in superfamilies according to their proved or presumed descent. Detailed basis of the superfamilies employed is discussed in the notes after the proposed classification below.

In the suborder Ammonitina a few families of the Perisphinctaceae and rare survivors of Oppeliaceae persist into the Lower Cretaceous from the Jurassic.

The remainder of the Cretaceous ammonites are regarded here as directly or indirectly derived from Phylloceratidae. The immediate offshoots are grouped in the polyphyletic family Desmoceratidae which comprises relatively unornamented forms and which was probably refreshed several times during the Cretaceous from Phylloceratidae; how many times is as yet uncertain since the various strands within the family have not been untangled. Three families that have taken on slightly stronger ornament but still retain many of the features of Desmoceratidae are joined with that family in a superfamily Desmoceratoceae, which lasts through the Cretaceous.

The more strongly ornamented and individualized ammonite stocks of the Cretaceous are grouped here into only two superfamilies, Hoplitaceae and Acanthoceratoceae. These are both groups of long standing, but their exact composition and the basis of the classification of their constituent families has been the subject of controversy. In particular the Hoplitaceae have often been regarded as including the Neocomian Berriasellidae, many genera of which have some resemblance in form to certain Aptian or Albian hoplitids. It is here maintained, following Spath, that, while Hoplitaceae are not derived from a single common ancestor, they are all the descendants of various Desmoceratidae that successively took on stronger ornamentation. Very few of these links have however yet been traced in detail (Leymeriellinae from *Callizoniceras* is an exception) and much work remains to be done.

It is probable that there was a burst of evolutionary activity among Desmoceratidae in the Hauterivian and Barremian that produced the Hemihoplitidae and Pulchelliidae; a second in the Lower Aptian producing Parahoplitidae, and through them Cheloniceratidae, Douvilléiceratidae and perhaps Engonoceratidae and Placenticeratidae; and finally in the Lower Albian a third producing independently Leymeriellinae, Gastroplitinae and the several strands of Cleoniceratinae. From the last subfamily came Hoplitinae and thence Schloenbachiidae.

Spath has now made it reasonably certain that the vast Albian family Hystatoceratidae and the smaller Lyelliceratidae both arose together from the *Brancoceras-Hystatoceras* group, itself derived from Desmoceratidae, in the late Lower Albian. Lyelliceratidae in turn gave rise at the end of the Albian to Acanthoceratidae, the details of whose subfamilies in the Cenomanian are now becoming clearer. Figure 2 shows the author's views of the development and differentiation of the Acanthoceratid stock and the way in which the Turonian and later

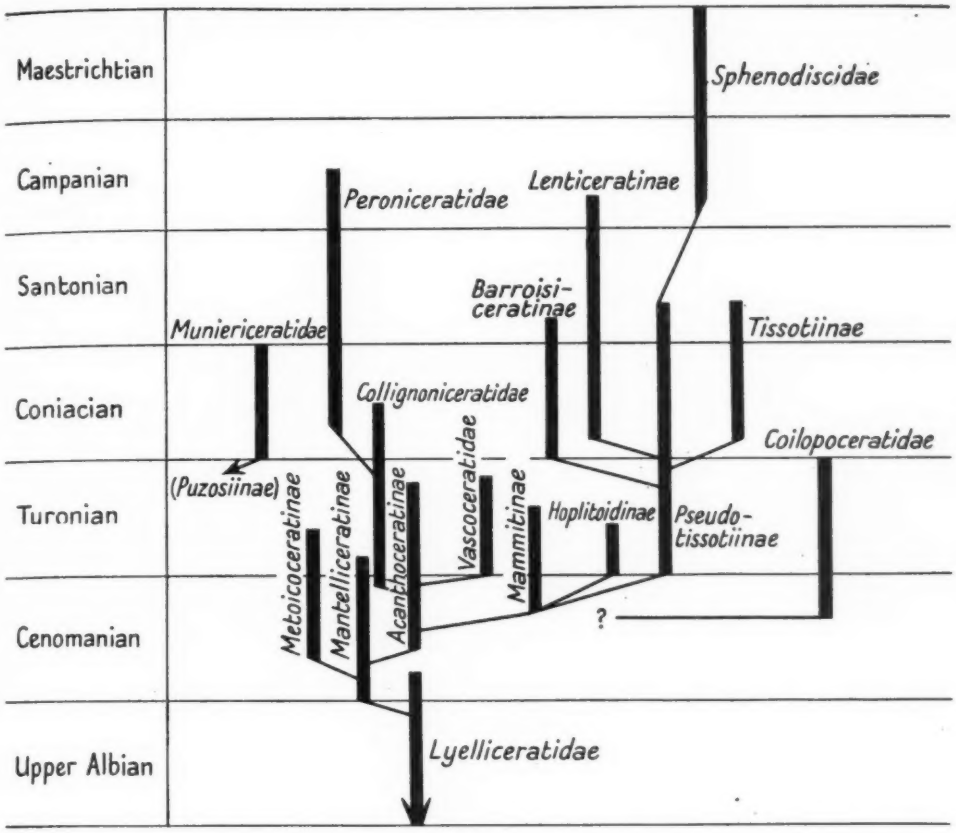


FIG. 2

aberrant families are probably attached to it. Much is still speculative, but if emphasis is laid on the transitional and often "unplaceable" early forms of a group rather than on the sutural or ornamental peculiarities of the fully evolved "typical" members relationships become easier to grasp.

THE PROPOSED CLASSIFICATION

NOTE—In order to give a complete outline of the Cretaceous ammonoidea there have been included a number of families and higher groups, marked with an asterisk, which occur also in the Jurassic. Most have already been covered in Arkell's classification of the Jurassic ammonites (1950).

ORDER *AMMONOIDEA de Haan 1825

Suborder **Phylloceratina* Arkell[1] 1950

Superfamily **Phylloceratacea* Hyatt 1900
Family *Phylloceratidae[2] Zittel 1884
Subfamily *Phylloceratinae s.s.
Subfamily *Calliphylloceratinae Spath 1927

[1] Arkell (1950) gave Hyatt, 1900, as the author both of the suborder Phylloceratina and the superfamily Phylloceratacea. In the author's opinion Hyatt's superfamily Phylloceratida cannot become both a suborder and a superfamily and consequently the suborder is here attributed to Arkell.

[2] Certain other subfamilies of Cretaceous Phylloceratidae have been proposed but are not adopted here. Too little is known of the differences in the internal suture for Hypophylloceratinae Spath 1927 to be accepted and the characters of inflation, involution and ribbing are not such as to justify the separation of Phyllopachyceratinae Collignon 1937 from Phylloceratinae s.s.

Suborder **Lytoceratina* Hyatt 1889

Superfamily **Lytoceratacea* Buckman 1894
Family **Lytoceratidae* Neumayr 1875
Subfamily **Lytoceratinae* s.s.
Subfamily Hemilytoceratinae Spath 1927
Family **Protetragonitidae* Spath 1927
Family Cicatritidae Spath 1937
Family Tetragonitidae Hyatt 1900
Family Gaudryceratidae Spath 1927
Family Jouaniceratidae[3] nov.
Superfamily **Crioceratitacea*[4] nov.
Family **Bochianitidae*[5] Spath 1922
Subfamily **Protancyloceratinae* Breistroffer 1947
Subfamily Bochianitinae s.s.
Family Crioceratitidae[6] Hyatt 1900 (syn. Pedioceratidae Hyatt 1900)
Superfamily Hamitacea Wright & Wright 1951
Family Ptychoceratidae[7] Meek 1876
Family Macroscaphitidae Hyatt 1900
Family Heteroceratidae Hyatt 1900
Family Ancyloceratidae[8] Meek 1876
Family Hamitidae Hyatt 1900
Family Baculitidae Meek 1876
Family Anisoceratidae Hyatt 1900
Family Algeritidae[9] Spath 1925
Family Phlycticrioceratidae Spath 1926
Family Turrilitidae Meek 1876
Family Nostoceratidae[10] Hyatt 1894
Family Diplomoceratidae Spath 1926
Superfamily Scaphitacea Wright & Wright 1951
Family Scaphitidae[11] Meek 1876

[3] Jouaniceratidae nov. for *Jouaniceras* Basse, with a single species from the Santonian of France. The shell begins as a turbinate spire but after two or three whorls reverts to normal coiling, the axis at right angles to that of the initial part.

[4] It might be suggested that this and the other heteromorphic superfamilies should be placed in Ammonitina, since many of their members have taken on strong ornament. Most of them however retain sufficient features of the ancestral Lytoceratina for them to be kept in that suborder.

Crioceratitaceae is here proposed for Crioceratidae and Bochianitidae. The former is now known from the Valanginian (*Aspinoceras* Anderson from California and undescribed forms from Kurdistan, according to kind information from Dr. Spath). Not only Bochianitinae but also Protancyloceratinae are now known from the Infra-Valanginian (information from Dr. Spath). It is, therefore, highly probable that Crioceratitidae are derived directly from Protancyloceratinae which in turn springs from Protetragonitidae (Spath 1950).

[5] Spath set up Bochianitinae, as a subfamily of Neocomitidae, in 1922, but in 1950 included the subfamily in Protancyloceratidae Breistroffer 1947. However, the earlier name must be used for the family if the two groups are to be united.

[6] Crioceratitidae includes Pedioceratidae Hyatt 1900, *Pedioceras* Gerhardt, being identical with *Pseudocrioceras* Spath, a Crioceratid.

[7] Ptychoceratidae Meek is revived here for such genera as *Ptychoceras* d'Orbigny, *Hamulina* d'Orbigny, *Hemibaculites* Hyatt and *Diptychoceras* Gabb, of the upper Hauterivian, Barremian, Aptian and Albian, which are primarily straight and rather smooth forms, with a single shaft or two or three parallel ones.

[8] Helicancylidae Hyatt 1894 may be a synonym. *Helicancylus* Gabb 1869 (type by monotypy *H. aequicostatum* Gabb = *H. gabbi* Anderson) has the helicoid spire of Heteroceratidae but the ornament of Ancyloceratidae. The sole species is too badly known for certain attribution.

[9] *Algerites* Pervinquière is superficially at least very similar to some *Idiohamites* Spath, a genus regarded by the present author as belonging to Anisoceratidae. Algeritidae, therefore, may have to be regarded as synonymous with the latter family.

[10] Nostoceratidae, as its author stated, includes forms with a great variety of modes of coiling. They are, however, at least as likely to be all secondarily uncoiled derivatives of Turrilitidae as independent offshoots of different Lytoceratacea, for example *Jouaniceras*. The family is a more natural one if it includes *Hyphantoceras* and *Bostrychoceras* Hyatt, often referred to Turrilitidae. The former occurs in North Africa as early as the Cenomanian and, with the Texan *Wintonia* Adkins, demonstrates that Turrilitids can uncoil. Diplomoceratidae, Dr. Spath has suggested to me, represent a further stage in the process and are uncoiled Nostoceratids.

[11] Scaphitidae are here regarded, following Spath 1937, as mainly monophyletic, but certain early forms, such as *Worthoceras* Adkins, probably had an independent origin.

Family Labeceratidae Spath 1925

Suborder **Ammonitina* Hyatt 1889

Superfamily **Oppeliaceae* Buckman 1924
Family *Haploceratidae[12] Zittel 1884
Family *Oppeliidae[13] Bonarelli 1893
Subfamily *Taramelliceratinae Spath 1928
Subfamily *Streblitinae Spath 1925
Superfamily **Perisphinctaceae* Wedekind 1917
Family *Berriasellidae Spath 1922
Subfamily *Berriasellinae s.s.
Subfamily *Himalayitinae Spath 1925
Subfamily *Paraboliceratinae Spath 1928
Subfamily Neocomitinae Spath 1924
Family Oosterellidae[14] Breistroffer 1940
Family *Craspeditidae Spath 1924
Family *Olcostephanidae Haug 1910
Subfamily Olcostephaninae s.s.
Subfamily *Spiticeratinae Spath 1925
Subfamily Polyptychitinae Spath 1924
Subfamily Simbirskitinae Spath 1924
Superfamily Desmoceratacea Wright & Wright 1951
Family Desmoceratidae[15] Zittel 1895
Subfamily Desmoceratinae s.s.
Subfamily Puzosiinae Spath 1922
Family Holcodiscidae Spath 1922
Family Aconeceratidae[16] Spath 1923
Family Pachydiscidae Spath 1922
Family Kossmaticeratidae Spath 1922
Family ?Flickiidae[17] Adkins 1928
Superfamily Hoplitaceae[18] (Spath 1922) Wright and Wright 1951
Family Hemihoplitidae[19] Spath 1924
Family Pulchelliidae H. Douvillé 1890
Family Parahoplitidae[20] Spath 1922

[12] Haploceratidae is represented in the Cretaceous by a single genus and species, *Neolissoceras grasianum* (d'Orbigny).

[13] Scattered survivors of Oppeliidae have been recorded from the Valanginian and Hauterivian of France and Madagascar.

[14] Although there are a number of very distinct end forms of Neocomitidae, for example *Saynella* and *Hatchericeras*, the appearance of *Oosterella* and *Pseudoosterella* is so peculiar that it is probably right they should constitute a separate family.

[15] This large family is polyphyletic in that it includes a large number of separate but similar offshoots of similar species of Phylloceratidae. Too little is yet known to sort out the many strands in the family and consequently it is impossible to set up a satisfactory system of subfamilies. Puzosiinae, in a restricted sense, is clearly separable but for the present it is advisable to leave all the rest in a single subfamily.

Breistroffer, 1947, has proposed that the generic name *Desmoceras* should be dropped. His proposal is, however, unnecessary. *Ammonites latidorsatus* Michelin was a valid genosyntype of *Desmoceras* Zittel, 1888, and was validly selected as type species by Boule, Lemoine and Therenin in 1906.

[16] With Oppeliidae known from the Hauterivian and Aconeceratids from Upper Hauterivian, the oft quoted similarity between the two groups might seem to be more than a case of convergence. However, the resemblance is here regarded as fortuitous.

[17] Flickiidae, which includes the type genus and *Adkinsia* Böse, is only doubtfully placed in this superfamily. Its simple sutures with entire lobes and saddles give no clue to the origin of the family and it is indeed quite distinct from any known family.

[18] Hoplitaceae includes a number of offshoots of Desmoceratacea. Although they are quite distinguishable, all the less specialized members of each offshoot are generally similar in ornament, suture and the tendency to marked differentiation of the venter.

Hyatt's superfamily Placenticeratida included two Hoplitacean families (Engonoceratidae and Placenticeratidae) and one Acanthoceratacean (Sphenodiscidae).

[19] It is reasonable to assume that Hemihoplitidae and the next two families were derived from some of the various Desmoceratidae of the period in which strong ornament begins to appear, but the particular links are uncertain.

[20] Stoyanow, 1949, divided Parahoplitidae into three subfamilies, Deshayesitinae, Parahoplitinae and Acanthohoplitinae. Despite the real differences between the first two groups, they are not com-

Subfamily Parahoplitinae s.s. (syn. Deshayesitinae Stoyanow 1949)
Subfamily Acanthohoplitinae Stoyanow 1949
Family Cheloniceratidae[21] Spath 1923
Family Douvilléiceratidae Spath 1922
Family Engonoceratidae[22] Hyatt 1900
Family Placenticeratidae Hyatt 1900
Family Coilopoceratidae[23] Hyatt 1903
Family Hoplitidae[24] H. Douvillé 1890
Subfamily Gastroplitinae[25] nov.
Subfamily Leymeriellinae[26] nov.
Subfamily Cleoniceratinae[27] Whitehouse 1926
Subfamily Hoplitinae s.s.
Family Schloenbachiidae Spath 1925
Subfamily Schloenbachiinae s.s.
Subfamily Forbesiceratinae[28] nov.

Superfamily Acanthocerataceae[29] Hyatt 1900

Family Hystatoceratidae[30] Hyatt 1900
Subfamily Hystatoceratinae s.s.

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mensurate with those between Acanthohoplitinae and the rest of the family and Deshayesitinae is regarded as unnecessary.

[21] Cheloniceratidae and Douvilléiceratidae are regarded as derived, probably separately, from Parahoplitidae. Spath, 1937, however has pointed to the possibility of the derivation of Cheloniceratidae from the lytoceratine *Cicatrites* Anthula.

[22] Engonoceratidae are in all probability directly derived from Parahoplitidae. *Knemiceras* Boehm has been recorded from the Aptian and some Parahoplitidae have simplifying sutures.

[23] An oxynote ammonite from Arabia which resembles a *Coilopoceras* but has the suture of the earliest Placenticeratidae (*Hypengonoceras* Spath), which are not very far removed in time and in form from *Knemiceras*, suggests that Coilopoceratidae can be assumed to have sprung from that genus. This is a more likely origin than Acanthoceratidae, as doubtfully suggested in figures 1 and 2.

[24] Just as the superfamily includes several distinct stocks, so does the family Hoplitidae itself. Gastroplitinae perhaps and Leymeriellinae certainly spring directly from Desmoceratidae, the latter by way of *Callizoniceras* Spath and *Wollemanniceras* Breistroffer. Cleoniceratidae are derived from various species of *Lemuroceras*, *Uhligella* and allied genera and Hoplitinae in turn from certain Cleoniceratinae.

As Breistroffer (1947, p. 84) points out the genus *Hoplites* Neumayr, 1875, is preoccupied, at least trebly apart from nomina nuda and illegitimate emendations of similar names. Breistroffer renamed the genus, made it (in the author's view unnecessarily) a subgenus of *Euhoplites* Spath and renamed the family Anahoplitidae, but the family name should be based on the name substituted for *Hoplites*. The author, however, has applied to the International Commission for the stabilization of the name *Hoplites* as a genus of ammonites.

[25] Gastroplitinae nov., for *Gastroplites* and *Neogastroplites* McLearn. The subfamily is characterized by pseudoceratitic sutures, flattened periphery and either ribs continuous over the venter or ventral tubercles that are opposite and not alternate.

[26] Leymeriellinae nov., for *Leymeriella* Jacob and the subgenera or genera *Proleymeriella* and *Epileymeriella* Breistroffer, is derived from the desmoceratid *Callizoniceras* Spath and leaves no descendants. The ribs are typically single but grooved and flattened on their outer half.

[27] Cleoniceratinae is not taken in quite the same sense as that employed by its author, Whitehouse, but is regarded as including all the closely related, strongly ornamented Desmoceratid derivatives of the Lower and Middle Albian in which the tendency to interruption of the ribs on the venter is not realized. Besides the genera that are transitional to various Hoplitinae, for example *Pseudosonneratia*, the subfamily includes some, such as *Cleoniceras* itself, that left no descendants.

[28] It is thought necessary to distinguish as Forbesiceratinae nov. the genera *Forbesiceras* Kossmat, *Tropitoides* Spath and *Prohauericeras* Nowák, which comprise compressed high whorled involute forms, generally with fine and dense sigmoid or falcate ribs and with sutures that are more complicated than in the rest of Schloenbachiidae.

[29] The attribution of this superfamily to Hyatt is made with some doubt, for none of the families here included were placed in his Acanthoceratida, while none of those in his Acanthoceratida are included here in the superfamily. Hyatt's Mammitida, on the other hand, comprised nearly all the groups now placed in Acanthocerataceae but his family Mammitidae included *Metacanthoplites* Hyatt, which is an objective synonym of *Acanthoceras* sensu stricto. For this reason, and because the family Acanthoceratidae dates from de Grossouvre, 1894, Mammitida must, I think, be treated as a synonym of Acanthocerataceae.

It might seem excessive to group all the remaining Cretaceous ammonites into a single superfamily. There are, however, close links at the points of origin of the various families and the most

Subfamily Mojsisovicziinae Hyatt 1900 (syn. Dipoloceratinae Spath 1921, Cechenoceratidae van Hoepen 1941)
Subfamily Mortoniceratinae[31] H. Douvillé 1911 (syn. Inflaticeratidae Spath 1921, Pervinquieriinae Spath 1926, Arestoceratidae van Hoepen 1942, Cainoceratidae van Hoepen 1942, Drepanoceratidae van Hoepen 1941)
Family Lyelliceratidae Spath 1921
Family Acanthoceratidae[32] de Grossouvre 1894
Subfamily Mantelliceratinae Hyatt 1903
Subfamily Acanthoceratinae s.s.
Subfamily Metoicoceratinae Hyatt 1903
Subfamily Mammitinae Hyatt 1900
Family Vascoceratidae H. Douvillé 1911
Family Collignoniceratidae[33] (Hyatt 1900) Wright & Wright 1951 (syn. Prionotropidae Hyatt 1900, Prionocyclidae Breistrotter 1947)
Family Peroniceratidae[34] Hyatt 1900 (syn. Texanitidae Collignon 1950)
Family Tissotiidae[35] Hyatt 1900
Subfamily Hoplitoidinae[36] H. Douvillé 1911
Subfamily Pseudotissotiinae Hyatt 1903
Subfamily Tissotiinae s.s. (syn. Buchiceratidae Hyatt 1903)
Subfamily Barroisiceratinae Basse 1947
Subfamily Lenticeratinae[37] Hyatt 1900 (syn. Eulophoceratidae Hyatt 1903)

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characteristic types of ornament are often repeated in different stocks at different horizons. The only alternative to the grouping here adopted would be to separate Hystatoceratidae as a separate superfamily (for which there is something to be said), to restrict Acanthocerataceae to Lyelliceratidae, Acanthoceratidae and the next three families and to form a third superfamily comprising the mixture of groups with the most specialized (though not necessarily the most complicated) sutures.

[30] Although the arrangement of Hystatoceratidae follows that of Spath (1942), his Dipoloceratinae, 1921 must give place to Mojsisovicziinae Hyatt, 1903, *Mojsisoviczia* Hyatt being a member of "Dipoloceratinae." The family name itself is somewhat doubtful. Hyatt set up *Hystatoceras* in 1900 as a nom. nov. for *Brancoceras* Steinmann 1881, non Hyatt 1884. Even though Hyatt's designated type species of *Hystatoceras* (*senequieri* d'Orbigny) may be generically separable from the lectotype species of *Brancoceras* Steinmann 1881 (*aegoceratoides*), it is difficult to regard *Hystatoceras* as other than a synonym of *Brancoceras* Steinmann. If this were accepted, the family name would be Brancoceratidae (Hyatt 1900) Spath 1934.

[31] The author follows Spath in believing that *Ammonites vespertinus* Morton is an identifiable and valid species and that there is, therefore, no reason to abandon the generic name *Mortoniceras* Meek of which the type by original designation was *A. vespertinus*. *Pervinquiera* Boehm is then either a synonym, a close ally, or a subgenus of *Mortoniceras*. In my view it is a synonym. In any case, the subfamily must be called Mortoniceratinae. It is attributed to Douvillé, although that author based it on the misinterpretation of *Mortoniceras* to cover the Senonian forms now referred to *Texanites*. On the taxonomic scale adopted here, van Hoepen's (1941 and 1942) families of keeled ammonites must be treated as synonyms of the several subfamilies of Hystatoceratidae.

[32] The family Acanthoceratidae is usually attributed to H. Douvillé, but so far as I can discover this attribution rests only on its appearance in an unpublished "Cours" or lecture notes distributed at the University.

[33] *Prionotropis* Meek is preoccupied and has been replaced by *Collignoniceras* Breistroffer, 1947. Haas, 1948 noted that this involved a change in the family name but argued that *Collignoniceras* should be treated as a subgenus of *Prionocyclus* and that the family name should therefore be Prionocyclidae. However the family name, on the change of *Prionotropis*, must automatically become Collignoniceratidae.

[34] Peroniceratidae is taken to include not only the type genus but also all the Senonian and Campanian "*Mortoniceras*," that is *Texaniles* Spath and its allies (separated by Collignon 1950 as Texanitidae), as well as *Gauthiericeras* through which *Peroniceras* itself is probably derived from Collignoniceratidae.

[35] Tissotiidae as used here is almost certainly polyphyletic, but only in a minor way. Too little however is known at present of the detailed relationships, and in many cases even the exact dates, of the many genera grouped in the family for a completely satisfactory classification to be proposed.

[36] *Hoplitoides* von Koenen probably originated in late Acanthoceratidae contemporarily with but independently of Pseudotissotiinae. It is most conveniently placed in a separate subfamily in Tissotiidae, next to Pseudotissotiinae.

[37] Lenticeratinae was described by Hyatt as a distinct family to include the type genus *Paralenticeras* and *Platylenticeras* Hyatt (the last a Valanginian craspeditid). It is retained here for the type genus and *Paralenticeras* Hyatt and for *Prelibycoceras* H. Douvillé, *Eulophoceras* Hyatt, *Pseudoschloenbachia* Spath and *Diaziceras* Spath. The first three genera are distinct and approximately contemporary offshoots, probably of some Pseudotissotiinae, and *Eulophoceras* and its more strongly ornamented contemporaries the direct descendants of *Prelibycoceras*. (But see Hourcq, 1949.)

Family Sphenodiscidae[38] Hyatt 1900
Family Muniericeratidae[39] nov.
Family Binneyitidae[40] Reeside 1928

[38] The derivation of Sphenodiscidae from Tissotiidae is reasonably certain but the actual connecting links with Pseudotissotiinae are not yet known.

[39] Muniericeratidae nov. for *Muniericeras* de Grossouvre, derived directly from *Tragodesmoceras* Spath and thence *Puzosia*. As Spath has suggested, various "Prionotropids" may be found to be derived from the same source or from *Muniericeras* itself but none has yet been definitely linked with this stock. The family is placed in Acanthocerataceae since the rest of that superfamily likewise springs from Desmoceratidae and *Muniericeras* is very similar to some Collignoniceratidae.

[40] Binneyitidae was established for the Coniacian *Binneyites* Reeside, whose ancestor is clearly the Turonian *Borissiakoceras* Arkhangelsky. This genus may in turn be derived from certain aberrant Acanthoceratids, probably referable to *Protacanthoceras* Spath.

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BIBLIOGRAPHY AND INDEX TO NEW GENERA, SPECIES AND VARIETIES OF FORAMINIFERA FOR THE YEAR 1950

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ABSTRACT—The following bibliography lists for the year 1950, 474 papers devoted partly or exclusively to Foraminifera. One hundred and sixty-seven titles are added for previous years.

The index to new genera, species and varieties (subspecies) of Foraminifera for the year 1950 records as new: one superfamily, 2 families, 3 subfamilies, 34 genera, 2 subgenera, 611 species, 92 varieties, 45 nomina nova, 19 nomina nuda, 19 homonyms and 161 forms to which the nomenclatura aperta was applied. Supplementary listings for years prior to 1950 include as new: one subfamily, 10 genera, 4 subgenera, 20 species, 2 varieties, 25 nomina nuda and 18 forms with nomenclatura aperta.

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SUPPLEMENT ON RUSSIAN FORAMINIFERAL LITERATURE 1950

After typing and numbering the manuscript, the author received from Dr. S. Boltovskoy (Buenos Aires) excerpts of Russian foraminiferal literature published during 1950. The following list of titles may not be complete, because several numbers of the "Doklady Akad. Nauk S.S.S.R.," namely vol. 70, nos. 5 and 6, vol. 71, nos. 1, 2, 3, 4, and 5, and vol. 74, no. 2 (all published during 1950) never reached Buenos Aires. Anyone who has opportunity to see these missing numbers would do a great service to his fellow-workers by either publishing the titles of foraminiferal papers or communicating them to the compiler for inclusion in a forthcoming "Bibliography of Foraminifera" in the Journal.

BOGDANOVICH, A. K., see DMITRIEVA, R. G., and BOGDANOVICH, A. K.

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Note—Number in bold-face type following author's name refers to index number of publication in preceding bibliography where complete reference is given.

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Ammobaculites auricularis Loeblich and Tappan, **245,** p. 6, pl. 1, figs. 12, 13. Lower Cretaceous, Kansas.

—— *cobbani* Loeblich and Tappan, **244,** p. 41, pl. 11, figs. 9–13. Oxfordian, South Dakota.

—— *esnehensis* Nakkady, **281,** p. 682, pl. 89, figs. 1, 2. Paleocene, Egypt.

—— —— —— var. *nudus* Nakkady, **281,** p. 683, pl. 89, fig. 3. Paleocene, Egypt.

—— *imlayi* Loeblich and Tappan, **244,** p. 42, pl. 11, fig. 17. Oxfordian, South Dakota.

—— *linea* Lalicker, **231,** p. 11, pl. 1, fig. 1. Bathonian, Montana.

—— *pyrenaicus* Ruiz de Gaona and Colom, **329,** p. 359, fig. 3, Nrs. 1–30. Upper Eocene, Spain.

—— *venustus* Loeblich and Tappan, **244,** p. 42, pl. 11, figs. 7, 8. Oxfordian, South Dakota.

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—— *kiowensis* Loeblich and Tappan, **245,** p. 5, pl. 1, fig. 3. Lower Cretaceous, Kansas.

—— *orbis* Lalicker, **231,** p. 11, pl. 1, fig. 2. Bathonian, Montana.

—— *parri* Crespin, **103,** p. 71, pl. 10, fig. 2. Lower Miocene, Victoria, Australia.

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—— *cragini* Loeblich and Tappan, **245,** p. 6, pl. 1, figs. 4–6. Lower Cretaceous, Kansas.

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Angulogerina earlandi Parr, **305,** p. 341, pl. 12, fig. 21. Recent, Antarctic. For: *Uvigerina angulosa* Heron-Allen and Earland, 1932 (non Williamson, 1858), Discovery Repts., vol. 4, p. 397, pl. 12, figs. 32–39.

Anomalina bassensis Parr, **305,** p. 363, pl. 15, fig. 5. Recent, off Tasmania.

—— *complanata* Reuss, 1851 var. *reussei* Khan, **221,** p. 277, pl. 2, figs. 17–18. Lower Gault, England. For: *Rosalina complanata* var. Reuss, 1863, (non *Anomalina complanata* Reuss, 1851), Akad. Wiss. Wien, Sitzber., vol. 46, Abhandl. 1, p. 86, pl. 11, fig. 3; and for: *Anomalina complanata* Chapman, 1898, (non Reuss, 1851), Roy. Micr. Soc. Jour., p. 3, pl. 1, fig. 4. (NOTE: The varietal name should be spelled "*reussi.*")

—— *fukushimaensis* Asano, **26,** p. 162, pl. 1, figs. 17, 18. Upper Cretaceous, Japan.

—— *luxorensis* Nakkady, **281,** p. 691, pl. 90, figs. 39–41. Top Paleocene, Egypt.

—— *pseudoacuta* Nakkady, **281,** p. 691, pl. 90, figs. 29–32. Basal Paleocene, Egypt.

—— *sakuensis* Asano, **24,** p. 22, pl. 3, fig. 18. Upper Cretaceous, Hokkaido, Japan.

—— *scrobiculata* Schwager, 1883, var. *esnehensis* Nakkady, **281,** p. 691, pl. 90, figs. 33, 34. Paleocene, Egypt.

—— *tasmanica* Parr, **305,** p. 363, pl. 14, fig. 4. Recent, off Tasmania.

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AOUJGALIA nov. gen. G. and H. Termier, **372,** p. 40. New genus of the family Spirillinidae. Genotype: *Aoujgalia variabilis* G. and H. Termier, 1950, ut infra. Visean.

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—— *operculiniformis* Henson, **190,** p. 44, pl. 7, figs. 5, 6. Oligocene, S.W. Iran.

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—— *aphrastus* Loeblich and Tappan, **244,** p. 45, pl. 12, figs. 1–4. Oxfordian, South Dakota.

—— *ectypus* Loeblich and Tappan, **246,** p. 8, pl. 1, figs. 14–18. Callovian, Wyoming. For: *Lenticulina sculpta* (Terquem and Berthelin) in Sandidge, 1933, Amer. Midland Natural., vol. 14, p. 179, pl. 1, fig. 10; and for: *Lenticulina sarthacensis* (Schwager) in Wickenden, 1933, Roy. Soc. Canada, Trans. (3), sect. 4, vol. 27, p. 160, pl. 1, fig. 10 (non figs. 9 and 11).

—— *petalus* Loeblich and Tappan, **246,** p. 8, pl. 1, figs. 19–21. Callovian, Wyoming.

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—— *aomoriense* Asano, **29,** p. 5, text figs. 27, 28. Upper Pliocene, Japan.
—— *hamadaense* Asano, **29,** p. 6, text figs. 29–31. Pliocene, Japan.
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—— *barkerensis* Frizzell and Schwartz, **156,** p. 6, pl. 1, figs. 1–6. Lower Cretaceous (Upper Albian), Texas.
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—— *sakuensis* Asano, **24,** p. 16, pl. 3, fig. 7. Upper Cretaceous, Hokkaido, Japan.
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Bigenerina nodosaria d'Orbigny, 1826, var. *hollandiae* van Voorthuysen, **411,** p. 54, pl. 1, fig. 5; text fig. 1. Pliocene, Holland.
Bolivina bassensis Parr, **305,** p. 338, pl. 12, fig. 15. Recent, off Tasmania.
—— *earlandi* Parr, **305,** p. 339, pl. 12, fig. 16. Recent, Antarctic. For: *Bolivina punctata* d'Orbigny in Earland, 1934, Discovery Repts., vol. 10, p. 132, pl. 6, figs. 5–7, and for: *B. punctata* d'Orbigny in Chapman and Parr, 1937, Australasian Antarct. Exped., 1911–14, Sci. Repts., ser. C, Zool and Botany, vol. 1, No. 2, p. 92, pl. 8, fig. 16.
—— *esnehensis* Nakkady, **281,** p. 687, pl. 89, fig. 16. Paleocene, Egypt.
—— *foxenensis* Bramlette, **67,** p. 58, pl. 23, figs. 19, 24. Miocene, California.
—— *himiensis* Chiji and Nakaseko, **90,** p. 519, text fig. 1. Miocene, Japan.
—— *serrato-suturalis* van Voorthuysen, **411,** p. 61, pl. 2, fig. 22; text fig. 3. Miocene (lower?), Holland.
—— *subcretacea* Khan, **221,** p. 274, pl. 2, figs. 6, 7. Lower Gault, England.
—— *woodi* Nakkady, **281,** p. 687, pl. 89, fig. 15. Paleocene, Egypt.
Bolivinoides decorata (Jones, 1886), subsp. *gigantea* Hiltermann and W. Koch, **193,** p. 610, text figs. 2–4, Nrs. 49–51, 55–57, 61–63; text fig. 5, Nr. 50. Upper Senonian, N.W. Germany. For: *Bolivinoides decorata* Jones in Dampel, 1934, Trans. Geol. Oil Inst. Leningrad, Ser. A, No. 50, p. 13, pl. 1, fig. 10; and for: *Bolivina* ex aff. *draco* in Wicher, 1942, Praktikum Angewandt. Mikropal., Berlin (Borntraeger), p. 67, pl. 26, fig. 22.
—— *draco* (Marsson, 1878) subsp. *miliaris* Hiltermann and W. Koch, **193,** p. 604, text figs. 2–4, Nrs. 26, 32–34, 39–41, 46–48; text fig. 5, Nr. 39. Upper Campanian, N.W. Germany. For: *Bolivinoides decorata* (Jones) in Cushman, 1927, Contr. Cushman Lab. Foram. Research, vol. 2, p. 89, pl. 12, fig. 9; and Cushman, 1946, U. S. Geol. Surv., Prof. Pap. 206, p. 113, pl. 48, figs. 8, 9; and for: *Bolivina* cf. *draco* in Wicher, Praktikum Angewandt. Mikropal., p. 67, pl. 26, fig. 21.
—— *seranensis* van der Sluis, **357,** p. 21, pl. 1, fig. 3. Upper Cretaceous, Ceram (Seran), Indonesia.
BOROVINA nov. gen. Schmalhausen, **625,** p. 869. New genus of the family Trochamminidae. Genotype: *Borovina zernovi* Schmalhausen 1951, ut infra. Recent, brackish water.
—— *zernovi* Schmalhausen, **625,** p. 870, text figs. 1–3. Recent, brackish water, Kazakhstan, Soviet Russia.
Botellina tasmanica Parr, **305,** p. 256, pl. 3, figs. 9, 10. Recent, off east coast of Tasmania, 155 meters.
—— *wiesneri* Parr, **305,** p. 255, pl. 3, figs. 6–8. Recent, Antarctic. For: *Botellina labyrinthica* Brady in Wiesner, 1931, Deutsche Sudpolar-Exped., vol. 20, p. 100, pl. 13, fig. 158; pl. 14, figs. 159, 160.
Boultonia cascadensis Thompson, Wheeler and Danner, **391,** p. 53, pl. 3, figs. 1–5. Permian, Washington.
Bulimina nojimaensis Asano, **30,** p. 4, text figs. 15, 16. Pliocene, Japan.
—— *submarginata* Parr, **305,** p. 336, pl. 12, fig. 13. Recent, off Tasmania.
Buliminella basicostata Parr, **305,** p. 336, pl. 12, figs. 11, 12. Recent, off Tasmania. For: *Bulimina elegantissima* d'Orbigny var. *seminuda* Terquem in Brady, 1884, Challenger Repts. Zool., vol. 9, p. 403, pl. 50, figs. 23, 24.
—— *bullina* Y. LeCalvez, **235,** p. 34, pl. 2, figs. 19, 20. Lutetian, Paris Basin, France.
—— *globulata* Barnard, **37,** p. 378, text fig. 1-e. Lias, England.
Calcitornella woodi Barnard, **40,** p. 6, pl. 1, figs. 3, 4; text fig. 1. Upper Lias, England. For: *Nubecularia lucifuga* Brady, Jones and Parker, 1860, Quart. Jour. Geol. Soc. London, vol. 16, p. 455, pl. 20, figs. 52–56. (Note: The author of the species name is Defrance, 1825, not Brady et al.)
Cancris carmenensis Natland, **282,** p. 32, pl. 9, fig. 1. Upper Pliocene, Lower California, Mexico.
Cassidulina asanoi Uchio, **217,** p. 190, text fig. 13. Upper Pliocene, Japan.
—— *laevigata* d'Orbigny, 1826, var. *pliocarinata* van Voorthuysen, **411,** p. 62, pl. 3, fig. 4; text fig. 4. Pliocene, Holland.
—— *nakamurai* Uchio, **217,** p. 190, text fig. 14. Upper Pliocene, Japan.
Cassidulinoides californiensis Bramlette, 67, p. 61, pl. 22, fig. 7. Miocene, California.
Ceratobulimina woodi Khan, **221,** p. 276, pl. 2, figs. 15, 16. Lower Gault, England. For: *Pulvinulina hauerii* d'Orbigny in Chapman, 1898, Jour. Roy. Micr. Soc. London, p. 5, pl. 1, fig. 7.
CERATOBULIMINOIDES nov. gen. Parr, **305,** p. 358. New genus of the family Discorbidae (recte:Discorbisidae). Genotype:

Ceratobuliminoides bassensis Parr, 1950, ut infra. Recent.
—— *bassensis* Parr, **305,** p. 359, pl. 14, fig. 12. Recent, off Tasmania.
Chabakovia (?) shulgae Elias, **141,** p. 300, pl. 43, figs. 14 (not fig. 4), 15. Lower Permian, N.W. Urals, Soviet Russia. For: "Spiral body" of Shulga-Nesterenko, 1941, Palaeont. of U.S.S.R., vol. 5, pt. 5, fasc. 1, (Acad. Sci. U.S.S.R.), pl. 54, fig. 5, text fig. 154.
Chilostomelloides macrostoma ten Dam and Sigal, **121,** p. 36, pl. 2, fig. 25. Dano-Montian, Algeria.
—— *plummerae* ten Dam and Sigal, **121,** p. 36, pl. 2, figs. 22–24. Dano-Montian, Algeria.
Cibicides abudurbensis Nakkady, **281,** p. 691, pl. 90, figs. 35–38. Paleocene, Egypt.
—— *cookei* Cushman and Garrett, 1938, var. *limbato-suturalis* van Voorthuysen, **411,** p. 65, text fig. 5. Paleocene, Holland.
—— *lobatulus* (Walker and Jacob, 1798) var. *expansus* Accordi, **7,** p. 21, text fig. 7. Upper Pleistocene, Italy. For: *Truncatulina lobatula* (Walker and Jacob) in: d'Orbigny, 1846, Foram. Foss. Bassin Vienne, pl. 9, figs. 18–20; and in Costa, G. O., 1856, Palaeont. Regno Napoli, pt. 2, pl. 14, fig. 7.
—— —— —— var. *inconsutus* Accordi, **7,** p. 20, text fig. 6. Upper Pleistocene, Italy.
—— —— —— var. *planatus* Accordi, **7,** p. 19, text fig. 3. Upper Pleistocene, Italy.
—— —— —— var. *praetumidus* Accordi, **7,** p. 22, text fig. 9. Upper Pleistocene, Italy.
—— —— —— var. *tympanoides* Accordi, **7,** p. 20, text fig. 5. Upper Pleistocene, Italy.
—— *multifaria* (Schwager, 1883) var. *mellahensis* Nakkady, **281,** p. 692, pl. 90, figs. 42–45. Paleocene, Egypt.
—— *praecursorius* (Schwager, 1883) var. *madhensis* Jacob and Sastri, **211,** p. 82, text fig. 10. Eocene (Laki series), Rajputana, India.
—— *pseudoconoides* Cita, **94,** p. 101, pl. 9, figs. 5, 6. Middle Eocene, Italy.
—— *roestae* A. M. Visser, **403,** p. 291, pl. 6, fig. 9. Maestrichtian, Holland.
—— *subhaidingeri* Parr, **305,** p. 364, pl. 15, fig. 7. Recent, off Tasmania. For: *Truncatulina haidingeri* (d'Orbigny) in: Brady, 1884, Challenger Exped., Zool., vol. 9, p. 663, pl. 95, fig. 7.
—— *subspiratus* Nuttall, 1930, var. *limbatus* Cita, **94,** p. 102, pl. 9, fig. 7. Middle Eocene, Italy.
Citharina entypomatus Loeblich and Tappan, **244,** p. 57, pl. 15, figs. 1–12. Oxfordian, South Dakota.
—— *glaberrima* ten Dam, **120,** p. 26, pl. 2, fig. 12. Albian, Holland.
—— *latissima* Loeblich and Tappan, **246,** p. 14, pl. 1, fig. 40; text fig. 2A–H. Callovian, Wyoming.
Citharinella compara Loeblich and Tappan, **246,** p. 14, pl. 1, fig. 36; text fig. 3A–D. Callovian, Wyoming.
—— *exarata* Loeblich and Tappan, **244,** p. 58, pl. 16, figs. 4–8. Oxfordian, South Dakota.
—— *laevis* ten Dam, **120,** p. 38, pl. 3, fig. 8. Albian, Holland.
—— *latifolia* Loeblich and Tappan, **246,** p. 15, pl. 1, fig. 35; text fig. 4A–C. Callovian, Wyoming.
—— *rhomboidea* Loeblich and Tappan, **244,** p. 58, pl. 16, figs. 1–3. Oxfordian, South Dakota.
Clavulinoides algeriana ten Dam and Sigal, **121,** p. 33, pl. 2, fig. 11. Dano-Montian, Algeria.
—— *rugulosa* ten Dam and Sigal, **121,** p. 32, pl. 2, figs. 8–10. Dano-Montian, Algeria.
Codonofusiella duffelli Thompson, Wheeler and Danner, **391,** p. 54, pl. 4, figs. 6, 9–12, ? 7, ? 8. Permian, British Columbia.
Cornuspira tasmanica Parr, **305,** p. 285, pl. 5, fig. 28. Recent, Antarctic.
COSCINOPHRAGMA nom. nov. See under chapter *nomina nova* 1950.
COSCINOPHRAGMINAE new subfam. Thalmann, 378, p. 221. Renamed subfamily for Polyphragminae of the family Placopsilinidae. Includes the genera *Haddonia* Chapman, 1898, *Stylolina* Karrer, 1877, *Stacheia* Brady, 1876, and *Coscinophragma* Thalmann, 1950.
Cribroelphidium aomoriense Asano, **29,** p. 11, text figs. 60, 61. Pliocene, Japan.
Cribrostomoides kyushuense Asano, **27,** p. 77, pl. 12, fig. 1. Miocene, Japan.
Cristellaria obliquecostata Wick, **421,** p. 12, pl. 4, figs. 12–18; pl. 8, figs. 6, 7. Paleocene, Northern Germany.
—— see also under *Robulus.*
Cyclammina japonica Asano, **27,** p. 78, pl. 11, figs. 3–8. Miocene, Japan.
—— *tasmanica* Parr, **305,** p. 274, pl. 4, fig. 28. Recent, Antarctic.
Darbyella pulchra Cita, **94,** p. 89, pl. 7, figs. 2, 3. Middle Eocene, Italy.
Dentalina ansa Lalicker, **231,** p. 15, pl. 2, fig. 6. Bathonian, Montana.
—— *antarctica* Parr, **305,** p. 329, pl. 11, figs. 26, 27. Recent, Antarctic.
—— *brachista* Loeblich and Tappan, **244,** p. 47, pl. 13, fig. 1. Oxfordian, South Dakota.
—— *ectadia* Loeblich and Tappan, **244,** p. 47, pl. 13, figs. 3–5. Oxfordian, South Dakota.
—— *ejuncida* Loeblich and Tappan, **244,** p. 48, pl. 13, figs. 9–11. Oxfordian, South Dakota.
—— *filistoma* ten Dam, **120,** p. 29, pl. 2, fig. 19. Albian, Holland.
—— *gracilistriata* Loeblich and Tappan, **246,** p. 10, pl. 1, fig. 24. Callovian, Wyoming.
—— *hancocki* Cushman and McCulloch, **112,** p. 316, pl. 41, fig. 7. Recent, Pacific, off San Clemente Island, 150 fathoms.
—— *hasta* Lalicker, **231,** p. 15, pl. 2, fig. 7. Bathonian, Montana.
—— *langi* Barnard, **37,** p. 361, text fig. 5-e. Lias, England. For: *Dentalina obliquestriata* Blake, 1876, in: Tate and Blake, The Yorkshire Lias, p. 460, pl. 19, fig. 4.
—— *leptosyna* Loeblich and Tappan, **244,** p. 48, pl. 13, fig. 2. Oxfordian, South Dakota.
—— *liota* Loeblich and Tappan, **244,** p. 48, pl. 14, figs. 13, 14. Oxfordian, South Dakota.
—— *ochyra* Loeblich and Tappan, **246,** p. 10, pl. 1, fig. 25. Callovian, Wyoming.
—— *polyholca* Loeblich and Tappan, **246,** p. 11, pl. 1, figs. 26–28. Callovian, Montana.
—— *subemaciata* Parr, **305,** p. 329, pl. 12, fig. 1. Recent, off Tasmania.

—— *translucens* Parr, **305,** p. 328, pl. 11, fig. 25. Recent, off Tasmania.

Dimorphina janjukensis Crespin, **103,** p. 73, pl. 10, fig. 11. Lower Miocene, Victoria, Australia.

Discorbina lacunae Silvestri, **354,** p. 61, pl. 3, figs. 22, 23. Recent, brackish water, Laguna Veneta, Italy.

Discorbis lobatulus Parr, **305,** p. 354, pl. 13, figs. 23–25. Recent, off Tasmania. For: *Discorbina isabelleana* (d'Orbigny) in Brady, 1884, Repts. Challenger, Zool., vol. 9, p. 646, pl. 88, fig. 1.

—— *ornatissimus* Cushman, 1925, var. *oregonensis* Bandy, **34,** p. 279, pl. 42, fig. 6. Pleistocene, Oregon.

—— *parkeri* Natland, **282,** p. 27, pl. 6, fig. 11. (Note: no age or locality stated but apparently from Pleistocene, Lower California, Mexico. The species name should read "*parkerae*" as it was erected in honor of Miss Frances L. Parker). For: *Discorbis nitida* Cushman and Parker, 1931 (non Williamson, 1858), U. S. Nat. Mus., Proc., vol. 80, Art. 3, p. 19, pl. 4, fig. 4.

—— *pseudoscopos* Nakkady, **281,** p. 688, pl. 90, figs. 2–4. Upper Cretaceous to basal Paleocene, Egypt.

———— —— var. *duwi* Nakkady, **281,** p. 689, pl. 90, figs. 5–7. Basal Paleocene, Egypt.

—— *subcomplanatus* Parr, **305,** p. 355, pl. 14, figs. 1, 2. Recent, Antarctic.

[—— *umbonifer* Parr, **305,** p. 353, pl. 13, fig. 22. Recent, off Tasmania, a homonym of Schwager, 1866, renamed *Discorbis parri* Thalmann nom. nov. See: Nomina nova 1950, ut infra.]

—— *wiesneri* Parr, **305,** p. 356, pl. 14, fig. 4. Recent, off Kerguelen. For: *Discorbina parisiensis* (d'Orbigny) in Brady: 1884, Repts. Challenger, Zool., vol. 9, p. 648, pl. 90, figs. 5, 6, 9–12.

Dorothia pusilla Parr, **305,** p. 282, pl. 5, fig. 23. Recent, off Tasmania.

—— *tortilis* Parr, **305,** p. 282, pl. 5, fig. 24. Recent, Antarctic.

Dyocibicides laevis Parr, **305,** p. 365, pl. 15, fig. 8. Recent, off Tasmania.

Eggerella subconica Parr, **305,** p. 281, pl. 5, fig. 22. Recent, off Tasmania. For: *Eggerella sp.* Parr, 1945, Roy. Soc. Victoria, Proc., n.s. vol. 56, p. 195, pl. 8, fig. 5.

Eggerellina mariae ten Dam, **120,** p. 15, pl. 1, fig. 17. Albian, Holland.

Ehrenbergina alicantina Colom, **102,** p. 5, text fig. 1. Burdigalian, Spain.

—— *pacifica* Cushman, 1927, var. *aspinosa* Parr, **305,** p. 345, pl. 13, figs. 1, 2. Recent, off Tasmania.

"*Ellipsoglandulina*" *fragilis* Bramlette, **67,** p. 60, pl. 22, figs. 4, 8–10. Miocene, California.

[*ELLISINA* Lalicker, **231,** p. 18, New genus of the family Polymorphinidae. Genotype: *Ellisina spatula* Lalicker, 1950, ut infra. Upper Jurassic. On account of homonymy with *Ellisina* Norman, 1903, a bryozoan, changed by Lalicker to *PEALERINA* nom. nov. See: Nomina nova 1950, ut infra.]

—— *spatula*, Lalicker, **231,** p. 19, pl. 4, fig. 3; text fig. 5. Bathonian, Montana. (Becomes now the genotype of *Pealerina* Lalicker, 1950, ut infra: see nomina nova 1950).

[*ELPHIDIOIDES* Parr, **305,** p. 373. New genus of the family Nonionidae. Lower Pliocene and Recent. On account of homonymy with *Elphidioides* Cushman, 1945 changed to *PARRELLINA* Thalmann 1950 nom. nov. See: Nomina Nova 1950, ut infra.]

Elphidium advenum (Cushman, 1922), subsp. *gorokuense* Takayanagi, **368,** p. 27, text fig. 4. Pliocene, Japan.

—— *ancestrum* Y. LeCalvez, **235,** p. 54, pl. 4, figs. 62, 63. Lutetian, Paris Basin, France. (Note: Y. LeCalvez designated this species as nom. nov. Since no references or synonymies are given, this form should be regarded as a spec. nov.)

—— (?) *clarki* Graham, **172,** p. 282, text fig. 1. Eocene, California.

—— *complanatum* (d'Orbigny, 1839) var. *tyrrhenicum* Accordi, **7,** p. 16, text fig. 2. Upper Pleistocene, Italy.

—— *haagensis* van Voorthuysen, **410,** p. 43, pl. 4, fig. 3; text fig. 9. Plio-Pleistocene, Holland.

—— *hokkaidoense* Asano, **29,** p. 8, text figs. 44, 45. Pliocene, Japan.

[—— *intermedium* (Silvestri, 1950), see: *Polystomella*, ut infra.]

—— *kerguelenense* Parr, **305,** p. 373, pl. 15, fig. 16. Recent, off Kerguelen.

—— *mawsoni* Parr, **305,** p. 372, pl. 15, fig. 15. Recent, off Kerguelen.

—— *sendaiense* Takayanagi, **368,** p. 26, text fig. 3. Pliocene, Japan.

—— *subincertum* Asano, **29,** p. 10, text figs. 56, 57. Pliocene, Japan.

—— *tsudai* Chiji and Nakaseko, **90,** p. 521, text fig. 2. Miocene, Japan.

Entosolenia semistriata Uchio, **217,** p. 190, text fig. 15. Upper Pliocene, Japan.

Eoguttulina amygdalina Loeblich and Tappan, **244,** p. 59, pl. 15, fig. 16. Oxfordian, South Dakota.

—— *axilla* Lalicker, **231,** p. 19, pl. 4, fig. 10. Callovian, Montana.

—— *pila* Lalicker, **231,** p. 19, pl. 4, fig. 4. Bathonian, Montana.

—— *vaga* Lalicker, **231,** p. 19, pl. 4, fig. 5. Bathonian, Montana.

Eouvigerina aegyptiaca Nakkady, **281,** p. 686, pl. 89, fig. 18. Paleocene, Egypt.

Epistomaria (*Epistomariella*) *miurensis* Kuwano, **228,** p. 315, text figs. 3, 10. Pliocene, Japan, Subgenotype of *EPISTOMARIELLA* subgen. nov. Kuwano, 1950. (See: Synonymy 1950, ut infra).

—— (——) *nakazatoensis* Kuwano, **228,** p. 316, text figs. 4, 11. Pliocene, Japan.

EPISTOMARIELLA subgen. nov. Kuwano, **228,** p. 315. A subgenus of *Epistomaria* Galloway, 1933, family Rotaliidae. Subgenotype: *Epistomaria* (*Epistomariella*) *miurensis* Kuwano, 1950, ut supra. Pliocene. (See: Synonymy 1950, ut infra.)

Epistomina liassica Barnard, **37,** p. 377, text figs. 9a–c. Lias, England.

Eponides blancoensis Bandy, **34,** p. 277, pl. 42, fig. 1. Pliocene, Oregon.

—— *carolinensis* Cushman, 1935, var. *navarraensis* Ruiz de Gaona and Colom, **329,** p. 377, fig. 14, Nrs. 5–10. Upper Eocene, Spain.
—— *lewinskii* Liszka, **242,** p. 188, pl. 5, fig. 5. Neocomian, Poland. (Note: species-name is mis-spelled "*liwinskii*" by Liszka.)
—— *pusillus* Parr, **305,** p. 360, pl. 14, fig. 16. Recent, off Tasmania.
Falsopalmula antrorsa Loeblich and Tappan, **244,** p. 57, pl. 15, fig. 13. Oxfordian, South Dakota.
Faujasina akitaensis Asano, **29,** p. 12, text figs. 68–70. Pliocene, Japan.
Fibrosa superfam. nov. G. and H. Termier, **372,** p. 37. Comprises the families Spirillinidae and Textulariidae.
Fissurina aperturo-alata Parr, **305,** p. 312, pl. 9, fig. 5. Recent, off Tasmania.
—— *basifimbriata* Parr, **305,** p. 312, pl. 9, figs. 6, 7. Recent, off Tasmania.
—— *bassensis* Parr, **305,** p. 309, pl. 8, fig. 12. Recent, off Tasmania.
—— *bimarginata* Parr, **305,** p. 311, pl. 9, figs. 3, 4. Recent, off Tasmania.
—— *collinsi* Parr, **305,** p. 311, pl. 8, fig. 4. Recent, off Tasmania.
—— *curvituba* Parr, **305,** p. 311, pl. 9, fig. 2. Recent, off Tasmania.
—— *earlandi* Parr, **305,** p. 306, pl. 8, fig. 8. Recent, Antarctica. For: *Lagena marginata* (Walker and Boys), in Chapman, 1916, Brit. Antarctic Exped. 1907–09, Repts., Sci. Invest. Geol., vol. 2 (3), p. 66, pl. 4, fig. 28; and for: *Lagena biancae* (Seguenza) in Heron-Allen and Earland, 1932, Discovery Repts., vol. 4, p. 372, pl. 10, figs. 35–39.
—— *fissicarinata* Parr, **305,** p. 309, pl. 8, fig. 11. Recent, Antarctic.
—— *formosa* (Schwager, 1866) var. *angusticarinata* Parr, **305,** p. 313, pl. 9, fig. 8. Recent, Antarctic.
—— *kerguelenensis* Parr, **305,** p. 305, pl. 8, fig. 7. Recent, Kerguelen. For: *Lagena staphyllearia* Schwager in Brady, 1884, Repts. Challenger, Zool., vol. 9, p. 474, pl. 59, figs. 8–11.
—— *pacifica* Parr, **305,** p. 314, pl. 9, fig. 10. Recent, off Tasmania. For: *Lagena* (*?*) *formosa* Schwager in Brady, 1884, Repts. Challenger, Zool., vol. 9, pl. 60, fig. 8 (fig. 18 on pl.); and for: *Lagena formosa* Schwager) in Sidebottom, Quekett Micr. Club, Jour., ser. 2, vol. 12, p. 192, pl. 17, fig. 4.
—— *quinqueannulata* Parr, **305,** p. 310, pl. 8, fig. 13. Recent, off Tasmania.
—— *subrevertens* Parr, **305,** p. 308, pl. 8, fig. 10. Recent, Antarctic, 456 meters.
—— *subcircularis* Parr, **305,** p. 311, pl. 8, fig. 15; pl. 9, fig. 1. Recent, off Tasmania.
—— *subformosa* Parr, **305,** p. 313, pl. 9, fig. 9. Recent, Antarctic.
Flourensina intermedia ten Dam, **120,** p. 15, pl. 1, fig. 16. Upper Albian, Holland.
Frankeina commutata Loeblich and Tappan, **246,** p. 6, pl. 1, figs. 3, 4. Callovian, Wyoming. For: *Frankeina sp.*? Wickenden, 1933, Roy. Soc. Canada, Trans. (3), sect. 4, vol. 27, pl. 1, fig. 2.
Frondicularia bassensis Parr, **305,** p. 331, pl. 12, figs. 4, 5. Recent, off Tasmania. For: *Frondicularia nitida* Terquem in Sidebottom, 1918, Roy. Micr. Soc. Jour., p. 137, pl. 4, fig. 18.
—— *californica* Cushman and McCulloch, **112,** p. 328, pl. 43, figs. 5–8. Recent, Pacific, off Lower California, Mexico.
—— *esnehensis* Nakkady, **281,** p. 685, pl. 89, fig. 23. Paleocene, Egypt.
—— *forma* Lalicker, **231,** p. 18, pl. 3, fig. 7. Bathonian, Montana.
—— *limbata* Barnard, **37,** p. 370, text fig. 7-d. Lias, England.
—— *mediostriata* ten Dam, **120,** p. 32, pl. 2, fig. 24. Albian, Holland.
—— *spatha* Lalicker, **231,** p. 17, pl. 3, fig. 6. Bathonian, Montana.
—— *victoriae* Crespin, **103,** p. 73, pl. 10, fig. 10. Lower Miocene, Victoria, Australia.
—— *wanneri* Nakkady, **281,** p. 685, pl. 89, fig. 22. Top Paleocene, Egypt. For: *Frondicularia sp.* Wanner, 1902, Palaeontogr., vol. 30, Abt. 2, p. 96, pl. 13, fig. 4.
Fusulinellinae subfam. nov. Rozovskaia, **596,** pp. 375–378 (article not seen by compiler).
Gaudryina karihaensis Asano, **23,** p. 6, pl. 2, fig. 2. Pliocene, Japan.
—— *soldadoensis* Cushman and Renz, 1942, var. *cavus-dulcis* Nakkady, **281,** p. 683, pl. 89, figs. 4, 5. Paleocene, Egypt.
—— (*Pseudogaudryina*) *niigataensis* Asano, **23,** p. 8, pl. 2, fig. 6. Pliocene, Japan.
—— (*Siphogaudryina*) *aissana* ten Dam and Sigal, **121,** p. 31, pl. 2, fig. 2. Dano-Montian, Algeria.
—— (——) *rectangularis* ten Dam and Sigal, **121,** p. 32, pl. 2, fig. 3. Dano-Montian, Algeria. (Note: cave *Gaudryina* (*Siphogaudryina*) *rectiangula* Lois Martin, 1943.)
Gaudryinella hanzawai Asano, **23,** p. 9, pl. 2, fig. 13. Pliocene, Japan.
—— *japonica* Asano, **23,** p. 9, pl. 2, figs. 11, 12. Pliocene, Japan.
—— *teshioensis* Asano, **24,** p. 20, pl. 3, fig. 6. Upper Cretaceous, Hokkaido, Japan.
Glandulina antarctica Parr, **305,** p. 334, pl. 12, figs. 8, 9. Recent, Antarctic.
Globigerina cretacea d'Orbigny, 1840, var. *esnehensis* Nakkady, **281,** p. 689, pl. 90, figs. 14–16. Basal Eocene, Egypt.
Globorotalia fohsi Cushman and Ellisor, 1939, var. *robusta* Bolli, **62,** p. 89, pl. 15, figs. 3a–c. Upper part Cipero Oligocene, Trinidad, B.W.I.
—— *rugosa* van der Sluis, **357,** p. 22, pl. 1, fig. 10. Upper Cretaceous, Seran (Ceram), Indonesia.
—— *seranensis* van der Sluis, **357,** p. 22, pl. 2, fig. 1. Upper Cretaceous, Seran (Ceram), Indonesia.
Globotruncana aegyptiaca Nakkady, **281,** p. 690, pl. 90, figs. 20–22. Basal Paleocene, Egypt.
—— —— —— var. *duwi* Nakkady, **281,** p. 690, pl. 90, figs. 17–19. Upper Cretaceous, Egypt.
—— *arca* (Cushman, 1926), var. *esnehensis* Nakkady, **281,** p. 690, pl. 90, figs. 23–26. Basal Paleocene, Egypt.
—— *flexuosa* van der Sluis, **357,** p. 21, pl. 1, figs. 7, 8. Upper Cretaceous, Seran (Ceram) Indonesia.

Goësella schencki Asano, **31,** p. 2, text figs. 11–13. Miocene, Japan.

GRZYBOWSKIA gen. nov. Bieda, **58,** p. 167. New genus of the family Nummulitidae. Genotype: *G. multifida* Bieda, 1950, ut infra. Bartonian.

—— *multifida* Bieda **58,** p. 168, pl. 3, figs. 1–9; pl. 4, figs. 1–3. Upper Eocene, Bartonian, Poland.

Gümbelina striata (Ehrenberg, 1838) var. *compressa* Nakkady, **281,** p. 686, pl. 89, fig. 19. Basal Paleocene, Egypt.

—— *ventilabrelliformis* van der Sluis, **357,** p. 21, pl. 2, fig. 2. Upper Cretaceous, Seran (Ceram), Indonesia.

Guttulina fraga Lalicker, **231,** p. 20, pl. 4, fig. 6. Bathonian, Montana.

—— *pera* Lalicker, **231,** p. 20, pl. 4, fig. 7. Bathonian, Montana.

—— *physalia* Loeblich and Tappan, **244,** p. 59, pl. 15, fig. 14. Oxfordian, South Dakota.

—— *spicaeformis* Roemer, 1838, var. *parisiensis* Y. LeCalvez, **235,** p. 15, pl. 1, figs. 10–12. Lutetian, Paris Basin, France.

—— *stilla* Lalicker, **231,** p. 20, pl. 4, fig. 8. Bathonian, Montana.

Gyroidina carmenensis Natland, **282,** p. 28, pl. 7, fig. 6. Middle Pliocene, Lower California, Mexico.

—— *rothwelli* Natland, **282,** p. 29, pl. 7, fig. 8. Pliocene, Lower California, Mexico. (Note: no type locality given.)

Hantkenina (*Applinella*) *trinitatensis* Bronnimann, **69,** p. 411, pl. 56, fig. 17. Upper Eocene, Trinidad, B.W.I. For: *Hantkenina liebusi var.* Shokhina, 1937, Moscow Univ., Lab. Paleont., Probl. in Paleont., vols. 2–3, p. 428, text figs. 3–5, 9, 10, 14, 15, and ? 30; and for: *Hantkenina dumblei* in: Rey, 1939, pro parte, Soc. géol. France, Bull., (5), vol. 8, p. 329, text fig. c.

—— (*Hantkenina*) *suprasuturalis* Bronnimann, **69,** p. 416, pl. 56, figs. 12, 13. Upper Eocene, Barbados, B.W.I. For: *Hantkenina alabamensis* Cushman in Rey, 1939, pro parte, Soc. géol. France, Bull. (5), vol. 8, pl. 22, fig. 17.

—— (——) *thalmanni* Bronnimann, **69,** p. 415, pl. 55, figs. 19–21; pl. 56, figs. 3, 11. Upper Eocene (San Fernando Group), Trinidad, B.W.I.

HANTKENINELLA subgen. nov. Bronnimann, **69,** p. 399. New subgenus of *Hantkenina* Cushman, 1925. Family Hantkeninidae. Subgenotype: *Hantkenina alabamensis* Cushman, 1925, var. *primitiva* Cushman and Jarvis, 1929, Cushman Lab. Foram. Research, Contr., vol. 5, p. 16, pl. 3, figs. 2, 3. Upper Eocene.

Haplophragmium slingeri Thomas, **386,** p. 288, pl. 1, figs. 1–6; text figs. 1–7. Oligocene, S.W. Iran.

Haplophragmoides cyclamminiformis G. and H. Termier, **372,** p. 39, pl. 1, figs. 1–3. Upper Visean, Morocco.

—— *ijimai* Asano, **24,** p. 17, pl. 3, fig. 11. Upper Cretaceous, Hokkaido, Japan.

—— *maroccana* G. and H. Termier, **372,** p. 39, pl. 1, figs. 4, 5. Upper Visean, Morocco.

—— *renzi* Asano, **27,** p. 77, pl. 12, fig. 3. Miocene, Japan. For: *Haplophragmoides coronatus* Brady in H. H. Renz, 1948. Geol. Soc. America, Mem. No. 32, p. 141, pl. 1, fig. 5.

—— *subtrullissatus* Parr, **305,** p. 271, pl. 4, fig. 27. Recent, Antarctic, 1718 meters. (Note: spelling of species name should read "*subtrullisatus*.")

—— *tryssa* Loeblich and Tappan, **244,** p. 41, pl. 11, fig. 2. Oxfordian, South Dakota.

Heronallenia laevis Parr, **305,** p. 357, pl. 14, fig. 8. Recent, off Tasmania.

—— *parva* Parr, **305,** p. 358, pl. 14, fig. 10. Recent, off Tasmania.

—— *polita* Parr, **305,** p. 358, pl. 14, fig. 9. Recent, Antarctic.

Hopkinsina magnifica Bramlette, **67,** p. 59, pl. 22, figs. 1–3, 5. Miocene, California.

—— *wakimotoensis* Asano, **30,** p. 19, text figs. 88–90. Pliocene, Japan.

Hormosina folkestoniensis Khan, **221,** p. 268, pl. 1, figs. 1–4. Lower Gault, England.

Hyperammina cylindrica Parr, **305,** p. 254, pl. 3, fig. 5. Recent, Antarctic. For: *Hyperammina elongata* Brady, 1884 (non Brady, 1878), Repts. Challenger, Zool., vol. 9, p. 257, pl. 23, figs. 4–7 (non figs. 8–10); and for: *Hyperammina elongata* Brady in Wiesner, 1931, Deutsche Sudpolar-Exped., 1901–03, vol. 20, Zool., vol. 12, p. 87, pl. 8, fig. 87.

—— *gaultina* ten Dam, **120,** p. 5, pl. 1, fig. 2. Albian, Holland. For: *Hyperammina species* (*n. sp.?*) Eichenberg, 1933, 25th Jahresber. Niedersachs. Geol. Verein, p. 2, pl. 1, fig. 6.

Karreriella pusilla Parr, **305,** p. 283, pl. 5, figs. 25, 26. Recent, Antarctic.

Kelyphistoma pemexa Limon-Gutierrez, **241,** p. 716, pl. 1, figs. 7–9. Upper Oligocene (Aquitanian), East Mexico.

Labrospira wiesneri Parr, **305,** p. 272, pl. 4, figs. 25, 26. Recent, Antarctic. For: *Trochammina trullissata* Brady 1884 (non Brady 1879), pro parte, Challenger Repts., Zool., vol. 9, p. 342, pl. 40, figs. 14, 15 (non figs. 13 and 16).

Lagena exomala Loeblich and Tappan, **245,** p. 12, pl. 2, fig. 11. Lower Cretaceous, Kansas.

—— *implicata* Cushman and McCulloch, **112,** p. 340, pl. 45, figs. 5–7. Recent, off Catalina Island, Pacific, California.

—— *inepta* Cushman and McCulloch, **112,** p. 341, pl. 45, figs. 11–13. Recent, Pacific, off Mexico, 15–20 fathoms.

—— *striatopunctata* Parker and Jones, 1865, var. *cista* Cushman and McCulloch, **112,** p. 352, pl. 47, figs. 14, 15. Recent, off Albermarle Island, Pacific, 80 fathoms.

—— —— —— var. *excentricitas* Cushman and McCulloch, **112,** p. 352, pl. 47, figs. 12, 13. Recent, Pacific, off Charles Island, 20 fathoms.

—— —— —— var. *gemma* Cushman and McCulloch, **112,** p. 353, pl. 47, fig. 16. Recent, Pacific, off Charles Island, 20 fathoms.

—— *subacuticosta* Parr, **305,** p. 302, pl. 8, fig. 3. Recent, Antarctic. For: *Lagena acuticosta* Reuss in Wiesner, 1931, Deutsche Sudpolar-Exped., vol. 20, p. 117, pl. 18, figs. 208–210.

—— *sulcata* (Walker and Jacob, 1798) var. *peculiaris* Cushman and McCulloch, **112,** p. 361, pl. 48, figs. 11–13. Recent, Pacific.

Lamarckina bienfaiti A. M. Visser, **403,** p. 263, pl. 5, fig. 4. Maestrichtian, Holland.

Laticarinina prima ten Dam and Sigal, **121,** p. 37, pl. 2, fig. 27. Dano-Montian, Algeria.

Lenticulina audax Loeblich and Tappan, **244,** p. 43, pl. 11, figs. 18–21. Oxfordian, South Dakota.

—— *dilecta* Loeblich and Tappan, **246,** p. 7, pl. 1, figs. 5–8. Callovian, Wyoming. For: *Lenticulina helios* (Terquem) in Sandidge, 1933, Amer. Midland Natural., vol. 14, p. 178, pl. 1, figs. 1, 2; and for: *Lenticulina sarthacensis* (Schwager) in Wickenden, 1933, Trans. Roy. Soc. Canada (3), sect. 4, vol. 27, p. 160, pl. 1, figs. 9 and 11 (non fig. 10).

—— *nakagawaensis* Asano, **24,** p. 21, pl. 3, fig.15 Upper Cretaceous, Hokkaido, Japan.

—— *pilicensis* Liszka, **242,** p. 187, pl. 5, figs. 1–3. Neocomian, Poland.

—— *subgibba* Parr, **305,** p. 321, pl. 11, figs. 1, 2. Recent, off Tasmania.

—— (*?*) *teshioensis* Asano, **24,** p. 21, pl. 3, fig. 19. Upper Cretaceous, Hokkaido, Japan.

Lenticulina (*Robulus*) *altifrons* Parr, **305,** p. 323, pl. 11, fig. 12. Recent, off Tasmania. For: *Cristellaria acutauricularis* (Fichtel and Moll) in Brady, 1884, Challenger Repts., Zool., vol. 9, p. 543, pl. 114, fig. 17.

—— (——) *antarctica* Parr, **305,** p. 323, pl. 11, fig. 11. Recent, Antarctic.

—— (——) *asterizans* Parr, **305,** p. 322, pl. 11, figs. 9, 10. Recent, Antarctic.

—— (——) *australis* Parr, **305,** p. 322, pl. 11, figs. 7, 8. Recent, off Tasmania.

—— (——) *suborbicularis* Parr, **305,** p. 321, pl 11, figs. 5, 6. Recent, off Tasmania.

—— (——) *tasmanica* Parr, **305,** p. 321, pl. 11, figs. 3, 4. Recent, off Tasmania.

Lepidocyclina (*Nephrolepidina*) *palauensis* Cole, **98,** pl. 25, pl. 5, figs. 12, 13. Miocene, Palau Islands.

Leptodermella maestrichtiensis A. M. Visser, **403,** p. 211, pl. 7, fig. 13. Maestrichtian, Holland.

Lingulina ampliata Loeblich and Tappan, **244,** p. 50, pl. 13, figs. 25, 26. Oxfordian, South Dakota.

—— *camerata* Loeblich and Tappan, **244,** p. 50, pl. 13, fig. 28, Oxfordian, South Dakota.

—— *charagmata* Loeblich and Tappan, **246,** p. 12, pl. 1, fig. 31. Callovian, Montana.

—— *hathra* Loeblich and Tappan, **246,** p. 12, pl. 1, figs. 29, 30. Callovian, Wyoming. For: *Frondicularia cf. franconica* Gümbel in Wickenden, 1933, Trans. Roy. Soc. Canada (3), sect. 4, vol. 27, p. 164, pl. 2, fig. 5; and for: *Frondicularia lingulaeformis* Schwager in Wickenden, 1933, ibid., p. 164, pl. 2, figs. 4 and 10.

—— *lordosa* Loeblich and Tappan, **244,** p. 51, pl. 13, fig. 24. Oxfordian, South Dakota.

—— *micida* Loeblich and Tappan, **244,** p. 51, pl. 13, figs. 29, 30, Oxfordian, South Dakota.

—— *rursa* Loeblich and Tappan, **246,** p. 12, pl. 1, fig. 32. Callovian, Montana.

—— *tumida* Loeblich and Tappan, **244,** p. 51, pl. 13, fig. 27. Oxfordian, South Dakota.

Loxostoma aegyptiaca Nakkady, **281,** p. 687, pl. 89, fig. 14. Paleocene, Egypt. (Note: the correct spelling of the genus name is *Loxostomum* because *Loxostoma* is preoccupied by *Loxostoma* Bivona-Bernardi, 1838, a mollusk.)

Marginulina caelata Loeblich and Tappan, **244,** p. 46, pl. 12, fig. 10. Oxfordian, South Dakota.

—— *clava* Lalicker, **231,** p. 13, pl. 1, fig. 8. Callovian, Montana.

—— *crepida* Lalicker, **231,** p. 14, pl. 2, figs. 4, 5. Bathonian, Montana.

—— *cymba* Lalicker, **231,** p. 13, pl. 1, fig. 10. Bathonian, Montana.

—— *diversicostata* Liszka, **242,** p. 188, pl. 5, fig. 4. Neocomian, Poland.

—— *erromena* Loeblich and Tappan, **244,** p.46, pl. 12, figs. 8, 9. Oxfordian, South Dakota.

—— *hancocki* Cushman and McCulloch, **112,** p. 309, pl. 40, figs. 9–11. Recent, off Lower California, Mexico, Pacific, 75 fathoms.

—— *perobesa* Parr, **305,** p. 326, pl. 11, fig.19. Recent, off Tasmania.

—— *rica* Lalicker, **231,** p. 14, pl. 2, fig. 2. Bathonian, Montana.

—— *ridica* Lalicker, **231,** p. 12, pl. 1, fig. 6. Bathonian, Montana.

—— *ruga* Lalicker, **231,** p. 13, pl. 1, fig. 9. Bathonian, Montana.

—— *sarpa* Lalicker, **231,** p. 14, pl. 1, fig. 11. Bathonian, Montana.

—— *scapha* Lalicker, **231,** p. 12, pl. 1, fig. 7. Bathonian, Montana.

—— *sicula* Lalicker, **231,** p. 14, pl. 1, fig. 12. Bathonian, Montana.

—— *sporta* Lalicker, **231,** p. 14, pl. 2, fig. 3. Bathonian, Montana.

—— *virga* Lalicker, **231,** p. 14, pl. 2, fig. 2. Bathonian, Montana.

—— *wetherellii* Jones, 1854, var. *intercostata* Nakkady, **281,** p. 684, pl. 89, fig. 12. Paleocene, Egypt.

—— —— —— var. *longicostata* Nakkady, **281,** p. 684, pl. 89, fig. 13. Paleocene, Egypt.

Marginulina (*Saracenaria*) *trigonalis* Barnard, **37,** p. 373, text fig. 5-c. Lias, England. (Note: cave *Marginulina trigona* Terquem, 1866.)

Marginulinopsis phragmites Loeblich and Tappan, **246,** p. 9, pl. 1, fig. 22, 23. Callovian, Wyoming. For: *Marginulina cf. lacunata* (Terquem) in Sandidge, 1933, Amer. Midland Natural., vol. 14, p. 180, pl. i, figs. 6–8, and in: Wickenden, 1933, Trans. Roy. Soc. Canada, (3), sect. 4, vol. 27, p. 162, pl. 1, fig. 13; and for *Marginulina cf. sparsa* (Terquem and Berthelin) in Wickenden, 1933, ibid., p. 161, pl. 1, fig. 14.

Martinottiella communis (d'Orbigny, 1826) var. *hosoyaensis* Asano, **31,** p. 3, text figs. 18, 19. Pliocene, Japan.

Massilina durhami Natland, **282,** p. 8, pl. 2, fig. 5. Pleistocene, Lower California, Mexico.

Meandropsina anahensis Henson, **190,** p. 47, pl. 6, figs. 4–9; pl. 8, fig. 10; pl. 9, fig. 4. Upper Oligocene, Iraq.

—— *iranica* Henson, **190,** p. 48, pl. 6, figs. 10, 11; pl. 10, figs. 4, 5, 7, 9, 10. Miocene, S.W. Iran.

Mississippina pacifica Parr, **305,** p. 361, pl. 14, fig. 17. Recent, off Tasmania.

Neoschwagerina brevis Thompson, Wheeler and

Danner, **391,** p. 59, pl. 6, figs. 3–6. Permian, Washington.

—— *morcropensis* Thompson, Wheeler and Danner, **391,** p. 59, pl. 6, figs. 7–11. Permian, Washington.

Nephrolepidina, see *Lepidocyclina*.

Nodosarella bulbosa ten Dam, **120,** p. 45, pl. 3, fig. 16. Albian, Holland.

Nodosaria amphigya Loeblich and Tappan, **244,** p. 48, pl. 13, figs. 15, 16. Oxfordian, South Dakota.

—— *balteata* Loeblich and Tappan, **244,** p. 49, pl. 13, figs. 6–8. Oxfordian, South Dakota.

—— *byfieldensis* Barnard, **40,** p. 17, pl. 3, fig. 2. Upper Lias, England.

—— *daedala* Loeblich and Tappan, **244,** p. 49, pl. 13, figs. 18, 19. Oxfordian, South Dakota.

—— *doliolaris* Parr, **305,** p. 330, pl. 12, fig. 2. Recent, Antarctic. For *Nodosaria raphanistrum* (Linne) in Earland, 1934, Discovery Repts., vol. 10, p. 169, pl. 7, figs. 42, 43.

—— *elegantia* Lalicker, **231,** p. 15, pl. 2, fig. 9. Bathonian, Montana. (Note: cave *Nodosaria elegans* v. Munster, 1838, *N. elegans* Neugeboren, 1852, and *N. elegans* Dunikowski, 1879.)

—— *fontannesi* (Berthelin, 1880) var. *flexocarinata* Khan, **221,** p. 269, pl. 1, fig. 6–8. Lower Gault, England.

—— *globulata* Barnard, **40,** p. 17, pl. 3, fig. 8; text fig. 9. Upper Lias, England.

—— *linea* Lalicker, **231,** p. 15, pl. 2, fig. 8. Bathonian, Montana.

—— *lirulata* Loeblich and Tappan, **244,** p. 49, pl. 13, figs. 12–14. Oxfordian, South Dakota.

—— *macula* Lalicker, **231,** p. 15, pl. 3, fig. 1. Bathonian, Montana.

—— *mecista* Loeblich and Tappan, **244,** p. 49, pl. 13, figs. 17, 20–22. Oxfordian, South Dakota.

—— *metensis* Terquem, 1863, var. *robusta* Barnard, **37,** p. 356, text fig. 3. Lias, England. For: *Nodosaria metensis* Terquem in: Franke, 1936, Abhandl. Preuss. Geol. Landesanst., N. F. Heft 169, p. 47, pl. 4, fig. 15a–c; and for: *Nodosaria metensis* Terquem in: Bartenstein, 1937, Abhandl. Senckenberg. Naturforsch. Ges., No. 439, p. 146, pl. 1-A, fig. 9; pl. 2-B, fig. 14 only.

—— *obscura* Reuss, 1845, var. *liassica* Barnard, **40,** p. 18, text fig. 10. Upper Lias, England, For: *Nodosaria obscura* Bartenstein and Brand, 1937 (non Reuss 1846), Abhandl. Senckenberg. Naturforsch. Ges. No. 439, p. 147, pl. 8, fig. 15.

—— *orbita* Lalicker, **231,** p. 16, pl. 3, fig. 2. Bathonian, Montana.

—— *orthostoecha* Loeblich and Tappan, **246,** p. 11, pl. 1, fig. 33. Callovian, Montana. For: *Nodosaria cf. corallina* Gumbel in Wickenden, 1933, Trans. Roy. Soc. Canada (3), sect. 4, vol. 27, p. 165, pl. 2, fig. 11.

—— *sphingothalama* Loeblich and Tappan, **246,** p. 11, pl. 1, fig. 34. Callovian, Montana.

Nonion akitaense Asano, **29,** p. 1, text figs. 1, 2. Pliocene, Japan.

—— *barleeanum* (Williamson, 1848) var. *inflatum* van Voorthuysen, **410,** p. 41, pl. 3, fig. 6; text fig. 7. Pleistocene, Holland. (Note: the varietal name is preoccupied by *Nonionina inflata* Alth, 1850, see: Homonyma 1950, ut infra. In van Voorthuysen, **411,** p. 66, species and variety are assigned to the genus *Anomalinoides*.)

—— *kidoharaense* Fukuta, **161,** p. 156, pl. 1, fig. 1. Lower Miocene, Japan.

—— —— —— var. *iwahorii* Fukata, **161,** p. 156, pl. 1, fig. 2. Middle Miocene, Japan.

—— *nanum* van Voorthuysen, **411,** p. 67, pl. 4, fig. 6. Middle Miocene, Holland.

—— *scapha* (Fichtel and Moll, 1803), var. *indica* Jacob and Sastri, **211,** p. 81, text fig. 3. Eocene (Laki series), Rajputana, India.

—— *togariense* Fukuta, **161,** p. 156, pl. 1, fig. 3. Middle Miocene, Japan.

—— *troostae* A. M. Visser, **403,** p. 250, pl. 6, fig. 13. Maestrichtian, Holland.

Nonionella globosa Ishiwada, **209,** p. 191, pl. 1, fig. 3. Recent, Japan Sea, 633 m.

Notorotalia kerguelensis Parr, **305,** p. 375, pl. 14, fig. 18; text fig. 8. Recent, off Kerguelen.

—— *patagonica* Parr, **305,** p. 375. Not figured. Recent, off Patagonia, 120 fathoms. For: *Rotalia clathrata* Brady, 1884, Challenger Repts., Zool., vol. 9, p. 709, pl. 107, fig. 9 (not fig. 8); and for same species in: Heron-Allen and Earland, 1932, Discovery Repts., vol. 4, p. 433, pl. 16, figs. 1–4.

Nubecularia permiana Johnson, **610,** p. 61, pl. 17, figs. 3, 4. Permian, West Texas.

Nummulites planulatus Lamarck, 1804, subsp. *bearnensis* Schaub and Schweighauser, **336,** text figs. 1–7. Ypresian, France.

Oolina heteromorpha Parr, **305,** p. 304, pl. 8, fig. 6. Recent, Antarctic, 1718 m.

—— *tasmanica* Parr, **305,** p. 303, pl. 8, fig. 4. Recent, off Tasmania.

Operculina campi Graham, **172,** p. 285, text fig. 2. Eocene, California.

—— *labanae* A. M. Visser, **403,** p. 253, pl. 1, fig. 18; pl. 10, figs. 2, 3. Maestrichtian, Holland. For: *Amphistegina fleuriausi* (d'Orbigny) form A-1 of Hofker, 1926, Natuurhist. Maandblad, Limburg, vol. 15, p. 80, text figs. 5–10.

Ophthalmidium rotula Lalicker, **231,** p. 11, pl. 1, fig. 3. Bathonian, Montana.

Orbitoides brinkae A. M. Visser, **403,** p. 296, pl. 9, fig. 5; pl. 11, figs. 2, 5. Maestrichtian, Holland. For: *Orbitoides faujasi* (Defrance) form A-2 in Hofker, 1926, Natuurhist. Maandblad, Limburg, vol. 15, p. 38, pl. 1, fig. 2; pl. 2, figs. 1, 2.

Orbitolites complanatus Lamarck, 1801, var. *minima* Henson, **190,** p. 58, pl. 3, fig. 1. Lutetian, Iraq.

Palmula sigmoicosta ten Dam and Sigal, **121,** p. 35, pl. 2, fig. 20. Dano-Montian, Algeria.

—— *toulmini* ten Dam and Sigal, **121,** p. 35, pl. 2, figs. 18, 19. Dano-Montian, Algeria.

—— *woodi* Nakkady, **281,** p. 684, pl. 89, fig. 24. Paleocene, Egypt.

—— —— —— var. *undulata* Nakkady, **281,** p. 685, pl. 89, fig. 25. Paleocene, Egypt (Note: no type locality given.)

Paleopolymorphina elacatoides Loeblich and Tap-

pan, **244,** p. 59, pl. 15, fig. 15. Oxfordian, South Dakota.
—— *gemma* Lalicker, **231,** p. 18, pl. 4, fig. 2. Bathonian, Montana.
Parafissurina abnormis Parr, **305,** p. 314, pl. 9, fig. 11. Recent, Antarctic, 220 meters.
—— *basicarinata* Parr, **305,** p. 314, pl. 9, figs. 12, 13. Recent, off Tasmania.
—— *biannulata* Parr, **305,** p. 315, pl. 9, fig. 14. Recent, off Tasmania.
—— *curta* Parr, **305,** p. 318, pl. 10, figs. 6, 7. Recent, Antarctic, 220 meters.
—— *magnilabiata* Parr, **305,** p. 316, pl. 9, fig. 18. Recent, off Macquarie Island, 69 meters.
—— *quadrata* Parr, **305,** p. 316, pl. 9, fig. 20. Recent, off Tasmania.
—— *scaphaeformis* Parr, **305,** p. 317, pl. 10, figs. 1–3. Recent, off Tasmania.
—— *spinosa* Parr, **305,** p. 318, pl. 10, fig. 8. Recent, Antarctic, 540 meters.
—— *subcarinata* Parr, **305,** p. 318, pl. 10, fig. 9. Recent, Antarctic, 540 meters.
—— *subcircularis* Parr, **305,** p. 318, pl. 10, fig. 10. Recent, off Tasmania.
—— *sublata* Parr, **305,** p. 319, pl. 10, fig. 11. Recent, off Tasmania.
—— *subovata* Parr, **305,** p. 319, pl. 10, figs. 12–14. Recent, off Kerguelen.
—— *tasmanica* Parr, **305,** p. 319, pl. 10, fig. 15. Recent, off Tasmania.
—— *tricarinata* Parr, **305,** p. 319, pl. 10, figs. 16–18. Recent, off Tasmania.
—— *wiesneri* Parr, **305,** p. 320, pl. 10, figs. 19, 20. Recent, Antarctic.
Parafusulina armstrongi Thompson and Verville, **389,** p. 69, pl. 9, figs. 1–7. Permian, British Columbia.
Patellina antarctica Parr, **305,** p. 352, pl. 13, figs. 19–21. Recent, Antarctic.
Patellina crista Lalicker, **231,** p. 20, pl. 4, fig. 11. Bathonian, Montana.
PEALERINA nom, nov. Lalicker, see: Nomina nova 1950, ut infra.
PELOSINELLA gen, nov. Parr, **305,** p. 261. A genus of the family Saccamminidae, subfamily Saccammininae. Genotype: *Pelosinella bicaudata* Parr, 1950, ut infra. Recent.
—— *bicaudata* Parr, **305,** p. 261, pl. 4, figs. 1, 2. Recent, Antarctic, 20–30 meters.
Peneroplis damesini Henson, **190,** p. 34, pl. 4, figs. 2, 3, 6; pl. 5, fig. 1. Upper Eocene, Iraq.
—— *dusenburyi* Henson, **190,** p. 32, pl. 4, figs. 1, 4, 5. Upper Eocene, Iraq.
—— *evolutus* Henson, **190,** p. 37, pl. 5, figs. 12–14; pl. 6, fig. 1; pl. 10, fig. 2. Middle Miocene, Iraq.
—— *farsensis* Henson, **190,** p. 33, pl. 5, figs. 3–6. Middle Miocene, Iraq.
—— *glynnjonesi* Henson, **190,** p. 35, pl. 9, figs. 8, 9. Lower to Middle Oligocene, Iraq.
—— *thomasi* Henson, **190,** p. 36, pl. 5, figs. 7–11. Upper Oligocene, Iraq.
PHENACOPHRAGMA gen. nov. Applin, Loeblich, and Tappan, **20,** p. 78. A genus of the family Lituolidae, subfamily Endothyrinae. Genotype: *Phenacophragma assurgens* Applin, Loeblich and Tappan, 1950, ut infra. Lower Cretaceous.
—— *assurgens* Applin, Loeblich and Tappan, **20,** p. 78, text figs. 4–6. Lower Cretaceous, Texas.
PLANISPIRINOIDES gen. nov. Parr, **305,** p. 287. A genus of the family Ophthalmidiidae. Genotype: *Miliolina bucculenta* Brady, 1884, Challenger Repts., Zool., vol. 9, p. 170, pl. 114, fig. 3. Recent.
Planularia alvarezi Limon-Gutierrez, **241,** p. 714, pl. 1, figs. 4–6. Upper Oligocene (Aquitanian), East Mexico. For: *Cristellaria budensis* Hantken in Nuttall, 1932, Jour. Paleon., vol. 6, p. 9, pl. 1, fig. 5.
—— *mariae* ten Dam, **120,** p. 24, pl. 2, fig. 9. Albian, Holland.
—— *planotrochiformis* Hussey and McNulty, **202,** p. 472, text figs. 1–9. Upper Cretaceous, Texas.
Planulina cushmani Ruiz de Gaona and Colom, **329,** p. 394, fig. 2, Nrs. 1–4. Upper Eocene, Spain.
Plectina nipponica Asano, **31,** pl. 2, text figs. 9, 10. Miocene, Japan.
Plectofrondicularia goharai Kuwano, **228,** p. 312, text fig. 7. Pliocene, Japan.
PLECTOGYRA gen. nov. Zeller, **434,** p. 3. A genus of the family Endothyridae. Genotype: *Plectogyra plectogyra* Zeller, 1950, ut infra. Mississippian.
—— *plectogyra* Zeller, **434,** p. 3, pl. 3, fig. 2. Upper Mississippian, Missouri.
PLECTOTROCHAMMINA gen. nov. Parr, **305,** p. 280. A genus of the family Trochamminidae. Genotype: *Plectotrochammina subglobosa* Parr, 1950, ut infra. Recent.
—— *subglobosa* Parr, **305,** p. 280, pl. 5, figs. 19, 20. Recent, Antarctic.
Polymorphina oregonensis Bandy, **34,** p. 275, pl. 41, fig. 4. Pliocene, Oregon.
Polystomella intermedia, Silvestri, **354,** p. 57, not figured. Recent, brackish water, Laguna Veneta, Italy. (Note: to be assigned to *Elphidium.*)
Praerhapydionina delicata Henson, **190,,** p. 52, pl. 2, figs. 4, 6, 9. Oligocene, Iraq.
—— *huberi* Henson, **190,** p. 53, pl. 2, figs. 5, 7, 8. Upper Eocene, Iraq.
Proteonina alexanderi Loeblich and Tappan, **245,** p. 5, pl. 1, figs. 1, 2. Lower Cretaceous, Kansas.
[*PROTOPENEROPLIS* gen. nov. Hofker, see: Homonyma 1950, ut infra.]
PROTOPENEROPLIS gen. nov. Weynschenk, **418,** p. 13. A genus of the family Peneroplidae. Genotype: *Protopeneroplis striata* Weynschenk, 1950, ut infra. Upper Jurassic.
—— *striata* Weynschenk, **418,** p. 13, pl. 2, figs. 12–14. Upper Jurassic, Tirol, Austria.
Psammophax tasmanica Parr, **305,** p. 257, pl. 3, figs. 15, 16. Recent, off Tasmania, 155 meters.
Pseudoclavulina globulifera ten Dam and Sigal, **121,** p. 32, pl. 2, figs. 5–7. Dano-Montian, Algeria.
Pseudodoliolina oliviformis Thompson, Wheeler and Danner, **391,** p. 58, pl. 5, figs. 7–11. Permian, Washington.
PSEUDOEPONIDES gen. nov. Uchio, **217,** p. 190. A genus of the family Rotaliidae. Genotype: *Pseudoeponides japonica* Uchio, 1950, ut infra. Upper Pliocene.

—— *japonica* Uchio, **217,** p. 190, text fig. 16. Upper Pliocene, Japan. (Note: see comment under: Synonymy 1950, ut infra.)

Pseudogaudryina traphera Loeblich and Tappan, **244,** p. 50, pl. 13, fig. 23. Oxfordian, South Dakota.

—— see also under *Gaudryina.*

Pseudogaudryinella compacta ten Dam and Sigal, **121,** p. 33, pl. 3, fig. 12. Dano-Montian, Algeria.

Pseudoglandulina multicostata (Bornemann, 1854) var. *semicostata* Barnard, **37,** p. 364, text fig. 4-b. Lias, England. For: *Nodosaria sp.* Wicher, 1938, Preuss. geol. Landesanst., Abhandl., N. F. Heft 193, pl. 23, fig. 4.

Pseudoparrella limburgensis Visser, **403,** p. 278, pl. 7, fig. 10. Maestrichtian, Holland.

—— *meeterenae* Visser, **403,** p. 278, pl. 7, fig. 9. Maestrichtian, Holland. (Note: genus name incorrectly spelled "*Pseudoparrelella.*")

—— *minisae* Visser, **403,** p. 279, pl. 7, fig. 8. Maestrichtian, Holland.

—— *naraensis* Kuwano, **228,** p. 317, text fig. 6. Pliocene, Japan.

[—— *purisima* (Bramlette, 1950), see: *Pulvinulinella.*]

—— *tamana* Kuwano, **228,** p. 317, text fig. 5. Pliocene, Japan.

PSEUDOPLANULINELLA gen. nov. Sigal, **353,** p. 63. A genus of the family Anomalinidae. Genotype: *Pseudoplanulinella hieroglyphica* Sigal, 1950, ut infra. Upper Oligocene (Rupelian and Aquitanian).

—— *hieroglyphica* Sigal, **353,** p. 64, text fig. 1-d, 2a–c, 3. Upper Oligocene (Aquitanian), France. (Note: Species name on explanation of text figure misspelled "*hierogliphyca.*")

—— —— —— var. *bartensteini* Sigal, **353,** p. 66, text fig. 4a, c. Upper Oligocene (Aquitanian), France.

Pseudopolymorphina avia Lalicker, **231,** p. 18, pl. 4, fig. 1. Bathonian, Montana.

—— *pera* Lalicker, **231,** p. 18, pl. 4, fig. 9. Bathonian, Montana.

Ptychocladia agellus Ulrich and Bassler, 1904, var. *rotaliformis* Elias, **141,** p. 295, pl. 43, fig. 10a (center of left edge). Pennsylvanian, Nebraska.

—— —— —— var. *tenuis* Elias, **141,** p. 295, pl. 43, figs. 8, 10–13; pl. 44, figs. 7, 10; pl. 45, fig. 3. Pennsylvanian, Nebraska.

—— *bassleri* Elias, **141,** p. 296, pl. 44 (not pl. 45!), figs. 11, 12. Upper Pennsylvanian, Nebraska.

Ptychocladiidae fam. nov. Elias, **141,** p. 288. Includes the genera: *Ptychocladia* Ulrich and Bassler, 1904 (olim: Bryozoa); *Chabakovia* Vologdin, 1939 (olim: alga), and *Bdelloidina* Carter, 1877.

Pullenia subsphaerica Parr, **305,** p. 346, pl. 13, fig. 6. Recent, Antarctic.

Pulvinulina lateralis (Terquem, 1878) var. *lacunae* Silvestri, **354,** p. 62, pl. 3, figs. 24, 25. Recent, brackish water, Laguna Veneta, Italy.

Pulvinulinella purisima Bramlette, **67,** p. 60, pl. 23, figs. 10–15. Miocene, California (In footnote 44a: assigned to *Pseudoparrella.* Note: the correct spelling of the species name is "*purissima.*")

[*PUTEOLUS* gen. nov. Hofker, **199,** p. 394, a new genus of the family Peneroplidae, with *Peneroplis proteus* d'Orbigny, 1839, in De la Sagra, Hist. Phys., Nat. etc. Cuba, "Foraminifères," p. 60, pl. 7, figs. 7–11, as genotype, is a homonym of *Puteolus* Monterosato, 1888, a mollusk. See: Homonyma 1950, ut infra.]

Pyrgo lateoralis Parr, **305,** p. 298, pl. 7, fig. 9. Recent, Antarctic.

—— *subglobulus* Parr, **305,** p. 298, pl. 7, fig. 10. Recent, off Tasmania.

—— *subpisum* Parr, **305,** p. 297, pl. 5, figs. 5, 6. Recent, Antarctic.

—— *wiesneri* Parr, **305,** p. 297, pl. 7, figs. 7, 8. Recent, Antarctic. For: *Biloculina sarsi* Schlumberger in Wiesner, 1931, Deutsche Südpolar-Exped., vol. 20, p. 110, pl. 16, fig. 194, and possibly 192 and 193.

Pyrulina carebara Loeblich and Tappan, **245,** p. 13, pl. 2, fig. 14. Lower Cretaceous, Kansas.

Quadratina inornata Loeblich and Tappan, **244,** p. 54, pl. 14, fig. 7. Oxfordian, South Dakota.

—— *juncta* Loeblich and Tappan, **244,** p. 54, pl. 14, fig. 8. Oxfordian, South Dakota.

QUERALTINA gen. nov. Marie, **256,** p. 73. New genus of the family Anomalinidae. Genotype: *Queraltina epistominoides* Marie, 1950, ut infra. Eocene (Priabonian and Bartonian).

—— *colomi* Marie, **256,** p. 77, text figs. 4a–c. Bartonian, Spain.

—— *crenata* Marie, **256,** p. 79, text fig. 6. Bartonian, Spain.

—— *epistominoides* Marie, **256,** p. 74, text figs. 1–3. Bartonian, France.

—— *hispanica* Marie, **256,** p. 78, text figs. 5a–c, 7. Bartonian, Spain.

Quinqueloculina akneriana d'Orbigny, 1846, var. *bellatula* Bandy, **34,** p. 273, pl. 41, fig. 1. Pleistocene, Oregon.

—— *anguina* Terquem, 1878, var. *wiesneri* Parr, **305,** p. 290, pl. 6, figs. 9, 10. Recent, off Tasmania.

—— *nanna* Loeblich and Tappan, **245,** p. 10, pl. 2, fig. 3. Lower Cretaceous, Kansas.

—— *ornithopetra* Crespin, **103,** p. 73, pl. 10, fig. 7. Lower Miocene, Victoria, Australia.

—— *singletoni* Crespin, **103,** p. 72, pl. 10, fig. 6. Lower Miocene, Victoria, Australia.

Ramulina fusiformis Khan, **221,** p. 272, pl. 2, figs. 1, 2. Lower Gault, England. For: *Marginulina cf. Dentalina aculeata* Berthelin, 1880, Mém. Soc. géol. France (3), vol. I, no. 5, p. 35, pl. 2, figs. 10–13; for: *Ramulina globulifera* Chapman, 1896, Jour. Roy. Micr. Soc. London, p. 582, pl. 12, figs. 3, 4; and for: *Ramulina sp.* Tappan, 1940, Jour. Paleont., vol. 14, p.114, pl. 18, fig. 4.

Ramulinella ecphyma Loeblich and Tappan, **244,** p. 59, pl. 15, fig. 17. Oxfordian, South Dakota.

Reophax brevis Parr, **305,** p. 265, pl. 4, figs. 9, 10. Recent, off Tasmania.

—— *davisi* Parr, **305,** p. 265, pl. 4, fig. 11. Recent, Antarctic.

—— *kerguelensis* Parr, **305,** p. 267, pl. 4, fig. 14. Recent, Kerguelen.

—— *pseudodistans* Cushman, 1919, var. *tenuis* Parr, **305,** p. 268, pl. 4, figs. 17, 18. Recent, off Tasmania, 117–145 meters.

—— *subdentaliniformis* Parr, **305,** p. 269, pl. 4, fig. 20. Recent, Antarctic. For: *Reophax dentaliniformis* Brady in Earland, 1934, Discovery Repts., vol. 10, p. 81, pl. 2, figs. 32–35.
—— *sundancensis* Loeblich and Tappan, **244,** p. 41, pl. 11, fig. 1. Oxfordian, South Dakota.
Reussella aegyptiaca Nakkady, **281,** p. 687, pl. 90, fig. 1. Upper Cretaceous, Egypt.
—— *haizumensis* Asano, **30,** p. 12, text fig. 51. Pliocene, Japan.
—— *secans* Y. LeCalvez, **235,** p. 48, pl. 3, figs. 7, 8. Lutetian, Paris Basin, France.
RHENOTHYRA gen. nov. Beckmann, **49,** p. 184. New genus of the family Lituolidae, subfamily Lituolinae. Genotype: *Rhenothyra refrathiensis* Beckmann, 1950, ut infra. Middle Devonian.
—— *refrathiensis* Beckmann, **49,** p. 184, text figs. 1–4. Upper part Middle Devonian, West Germany.
Robertina tasmanica Parr, **305,** p. 369, pl. 15, figs. 10, 11. Recent, off Tasmania.
—— *wiesneri* Parr, **305,** p. 369, pl. 15, fig. 9. Recent, Antarctic. For: *Robertina subteres* (Brady) in Wiesner, 1933, Deutsche Südpolar-Exped., vol. 20, p. 124, pl. 20, fig. 238.
Robulus bulla Lalicker, **231,** p. 12, pl. 1, fig. 5. Bathonian, Montana.
—— *denticulifera* (Cushman, 1913) var. *bartoniana* Ruiz de Gaona and Colom, **329,** p. 403, fig. 8, Nrs. 1–8. Upper Eocene, Spain.
—— *ellisana* Lalicker, **231,** p. 11, pl. 1, fig. 4. Bathonian, Montana.
—— *futabaensis* Asano, **26,** p. 159, pl. 1, fig. 12. Upper Cretaceous, Hokkaido, Japan.
—— *himiensis* Chiji and Nakaseko, **90,** p. 521, text fig. 4. Miocene, Japan.
—— *mellahensis* Nakkady, **281,** p. 683, pl. 89, figs. 8, 9. Upper Cretaceous, Egypt (no type locality stated).
—— —— —— var. *obesus* Nakkady, **281,** p. 683, pl. 89, figs. 10, 11. Paleocene, Egypt (no type locality given). Note: see comment under Homonyma 1950, ut infra.
—— *olianensis* Ruiz de Gaona and Colom, **329,** p. 406, fig. 10, Nrs. 11–19. Upper Eocene, Spain.
—— *yoshitakiensis* Chiji and Nakaseko, **90,** p. 521, text fig. 3. Miocene, Japan.
—— see also under *Lenticulina*.
Rotalia crookshankiana Jacob and Sastri, **211,** p. 81, text fig. 7. Eocene (Laki series), Rajputana, India.
—— *ketienziensis* (Ishizaki, 1943) subsp. *angulata* Kuwano, **228,** p. 312, text figs. 1, 9. Pliocene, Japan.
—— *maruhasii* Kuwano, **228,** p. 314, text figs. 2, 8. Pliocene, Japan.
—— *subcorpulenta* Bandy, **34,** p. 278, pl. 42, fig. 8. Pleistocene, Oregon.
—— *subgranulosa* Jacob and Sastri, **211,** p. 81, text fig. 6. Eocene (Laki series), Rajputana, India.
—— *tenerrima* Bandy, **34,** p. 278, pl. 42, fig. 3. Pliocene, Oregon.
Saracenaria cypha Loeblich and Tappan, **244,** p. 54, pl. 14, figs. 9–11. Oxfordian, South Dakota.
—— *italica* Defrance, 1824, var. *politus* Khan, **221,** p. 270, pl. 1, figs. 9, 10. Lower Gault, England.
—— *tunesiana* ten Dam and Sigal, **121,** p. 36, pl. 2, fig. 21. Dano-Montian, Tunisia.
—— see also under *Marginulina*.
Schenckiella antarctica Parr, **305,** p. 284, pl. 5, fig. 27. Recent, Antarctic. For: *Clavulina communis* d'Orbigny in Wiesner, 1931, Deutsche Südpolar-Exped., vol. 20, p. 100, pl. 13, figs. 156, 157; and in Earland, 1933, Discovery Repts., vol. 7, p. 100, pl. 3, figs. 39–42.
Schwagerina andersoni Thompson, Wheeler and Danner, **391,** p. 55, pl. 4, figs. 1–5; possibly pl. 8, fig. 13. Permian, Washington, For: *Leeina ? sp.* Anderson, 1941, Washington State Coll. Research Studies, vol. 9, p. 194, pl. 2, fig. 2.
—— *caurus* Thompson, Wheeler and Danner, **391,** p. 55, pl. 3, figs. 6–11. Permian, Washington.
Sigmoilina bartoniensis Ruiz de Gaona and Colom, **329,** p. 410, fig. 17. Nrs. 1–16. Upper Eocene, Spain.
—— *sabulosa* Parr, **305,** p. 292, pl. 6, fig. 17. Recent, off Tasmania.
Sigmomorphina apiculata Y. LeCalvez, **235,** p. 24, pl. 4, figs. 51–53. Lutetian, Paris Basin, France.
—— *kronenburgae* A. M. Visser, **403,** p. 246, pl. 3, fig. 3. Maestrichtian, Holland.
—— *polyphysalis* Accordi, **7,** p. 15, text fig. 1. Upper Pleistocene, Italy.
Silicosigmoilina futabaensis Asano, **26,** p. 159, pl. 1, figs. 6, 7. Upper Cretaceous, Hokkaido, Japan.
Siphogaudryina, see under *Gaudryina*.
Siphogenerina esnehensis Nakkady, **281,** p. 688, pl. 89, fig. 17. Top Upper Cretaceous, and Paleocene, Egypt.
Siphogenerinoides oveyi Nakkady, **281,** p. 686, pl. 89, fig. 20. Top of Upper Cretaceous, Egypt.
—— —— —— var. *compressa* Nakkady, **281,** p. 687, pl. 89, fig. 21. Top Upper Cretaceous, Egypt.
SIPHOGLOBULINA gen. nov. Parr, **305,** p. 323. New genus of the family Polymorphinidae. Genotype: *Siphoglobulina siphonifera* Parr, 1950, ut infra. Eocene, Miocene, Recent.
—— *siphonifera* Parr, **305,** p. 333, pl. 12, figs. 6, 7; text fig. 6. Miocene, Balcombian, Victoria (holotype), Australia.
Siphotextularia obesa Parr, **305,** p. 276, pl. 5, fig. 1. Recent, off Tasmania.
—— *olianensis* Ruiz de Gaona and Colom, **329,** p. 413, fig. 16, Nrs. 1–9. Upper Eocene, Spain.
SIPHOUVIGERINA gen. nov. Parr, **305,** p. 342. New genus of the family Buliminidae. Genotype: *Uvigerina porrecta* Brady, 1879, var. *fimbriata* Sidebottom, 1918, Jour. Roy. Micr. Soc. London, p. 147, pl. 5, fig. 23. Recent.
Somalina danieli Henson, **190,** p. 60, pl. 3, figs. 2, 3. Lutetian, Iraq.
Sorites grecoensis Henson, **190,** p. 56, pl. 6, fig. 14; pl. 7, figs. 1, 2. Miocene (Helvetian), Cyprus.
Spirillina amphelicta Loeblich and Tappan, **244,** p. 60, pl. 16, fig. 11. Oxfordian, South Dakota.

—— ***multispira*** Parr, **305,** p. 349, pl. 13, fig. 10. Recent, off Tasmania.
—— ***obconica*** Brady, 1879, var. *dorsoserrata* Parr, **305,** p. 350, pl. 13, fig. 11 Recent, Antarctic.
—— ***pectinimarginata*** Chapman, Parr and Collins, 1934, var. *aspinosa* Parr, **305,** p. 348, pl. 13, fig. 7. Recent, off Tasmania.
—— ***radiosa*** Parr, **305,** p. 350, pl. 13, figs. 12–14. Recent, Antarctica.
—— ***ticinensis*** Schweighauser, **344,** p. 323, text figs. 1, 4, 7, 8. Liassic, Southern Switzerland.
Spiroloculina angusteoralis Parr, **305,** p. 292, pl. 6, fig. 15. Recent, shore sands, Victoria, Australia.
—— ***nitida*** d'Orbigny, 1826, var. *chordata* Silvestri, **354,** p. 28. Not figured. Recent, brackish water, Laguna Veneta, Italy.
—— —— —— var. *dilatata* Silvestri, **354,** p. 28. Not figured. See comments regarding homonymy under chapter Homonyma 1950.
—— ***pellucida*** Said, **331,** p. 7, pl. 1, fig. 12. Recent, Red Sea, 596 meters.
—— ***subimpressa*** Parr, **305,** p. 291, pl. 6, figs. 12, 13. Recent, off Tasmania.
—— ***sublimbata*** Parr, **305,** p. 291, pl. 6, fig. 14. Recent, off Western Australia. 69 meters.
Spiroplectammina ezoana Asano, **24,** p. 18, pl. 3, fig. 5. Upper Cretaceous, Hokkaido, Japan.
—— ***rectangularis*** ten Dam, 1947, var. *cretosa* ten Dam, **120,** p. 11, pl. 1, fig. 9, Albian, Holland. (Note: preoccupied by Cushman 1932, see Homonyma 1950, ut infra.)
Stensiöina esnehensis Nakkady, **281,** p. 689, pl 90, figs. 8–10. Paleocene, Egypt.
STOMATOSTOECHA Applin, Loeblich and Tappan, **20,** p. 76. New genus of the family Lituolidae, subfamily Endothyrinae. Genotype: *Stomatostoecha plummerae* Applin, Loeblich and Tappan, 1950, ut infra. Lower Cretaceous.
—— ***plummerae*** Applin, Loeblich and Tappan, **20,** p. 76, text figs. 1–3. Lower Cretaceous, Texas.
Streblus beccarii (Linnaeus 1758) var. *globosus* van Voorthuysen, **411,** p. 68, pl. 4, fig. 8. Pliocene, Holland.
—— —— —— var. *pseudotepidus* van Voorthuysen, **410,** p. 45, pl. 4, fig. 8; text fig. 13. Pliocene and Pleistocene, Holland.
Suggrunda eckisi Natland, **282,** p. 22, pl. 9, fig. 12. Pliocene, Lower California, Mexico. For: *Bolivina pygmaea* Brady in Cushman and Moyer, 1930, Contr. Cushman Lab. Foram. Research, vol. 6, p. 57, pl. 8, fig. 4.
—— ***kleinpelli*** Bramlette, **67,** p. 59, pl. 23, figs. 4, 5, 9. Miocene, California.
Taberina daviesi Henson, **190,** p. 51, pl. 1, figs. 1–3; pl. 2, figs. 1–3. Paleocene, Iraq.
Textularia andenensis Asano, **31,** p. 2, text figs. 5, 6. Pliocene, Japan.
—— ***australis*** Parr, **305,** p. 275, pl. 4, fig. 30. Recent, off Western Australia.
—— ***ornatissima*** Said, **331,** p. 4, pl. 1, fig. 6. Recent, Red Sea, 265 meters.
Textulariella cushmani ten Dam and Sigal, **121,** p. 33, pl. 2, figs. 13–16. Dano-Montian, Algeria.
Tholosina spiculifera Parr, **305,** p. 262, pl. 4, fig. 4. Recent, Antarctic.
TREMASTEGINA gen. nov. Bronnimann, **74,** p. 256. New genus of the family Asterigerinidae. Genotype: *Amphistegina senni* Cushman in Vaughan, 1945, Geol. Soc. America, Mem. 30, pt. 1, p. 49, pl. 19, fig. 1. Middle Eocene.
Tribrachia inelegans Loeblich and Tappan, **246,** p. 16, pl. 1, fig. 39. Callovian, Wyoming.
—— ***reussi*** Bartenstein and Brand, **46,** p. 121, pl. 1, figs. 1, 6, 7. Cretaceous, Germany, For: *Frondicularia cordai* Reuss var. *tribrachiata* Reuss, 1846, Verst. Böhm. Kreideform., vol. 2, p. 108, pl. 24, fig. 38; for *Frondicularia inversa* Reuss in Beissel, 1891, Abhandl. k. Preuss. Geol. Landesanst., N.F. Heft 3, p. 44, pl. 8, figs. 47–49.
—— ***schuberti*** Bartenstein and Brand, **46,** p. 123, pl. 2, fig. 9. Upper Cretaceous, Germany. For: *Frondicularia turgida* Reuss, 1846, "monströse Form," Verst. Böhm. Kreideform., vol. 2, p. 107, pl. 24, fig. 41.
—— ***subcretacea*** Bartenstein and Brand, **46,** p. 125, pl. 2, fig. 11. Upper Valanginian, N. Germany.
—— ***westfalica*** Bartenstein and Brand, **46,** p. 122, pl. 1, fig. 8. Senonian, Germany.
Triloculina lamellidens Parr, **305,** p. 294, pl. 7, fig. 2. Recent, off Tasmania, 122–155 meters.
—— ***striatula*** Parr, **305,** p. 294, pl. 7, fig. 1. Recent, off West Australia, 62 meters.
—— ***subvalvularis*** Parr, **305,** p. 296, pl. 5, fig. 4. Recent, Antarctic.
TRILOCULINELLA gen. nov. Riccio, **322,** p. 90. New genus of the family (not stated) Miliolidae. Genotype: *Triloculinella obliquinodus* Riccio, 1950, ut infra. Lower Pleistocene; Recent.
—— ***obliquinodus*** Riccio, **322,** p. 90, pl. 15, figs. 1, 2. Lower Pleistocene, California.
Tristix alcima Loeblich and Tappan, **244,** p. 52, pl. 14, fig. 6. Oxfordian, South Dakota.
—— ***gaultina*** Khan, **221,** p. 270, pl. 1, figs. 11, 12. Lower Gault, England.
—— ***nitidula*** Loeblich and Tappan, **246,** p. 13, pl. 1, fig. 37. Callovian, Wyoming. For: *Dentalinopsis oolithica ?* (Terquem) in Wickenden, 1933, Trans. Roy. Soc. Canada (3), sect. 4, vol. 27, p. 167, pl. 2, fig. 6.
—— ***reesidei*** Loeblich and Tappan, **244,** p. 53, pl. 14, figs. 1–5. Oxfordian, South Dakota.
Tritaxia subrotundata ten Dam, **120,** p. 12, pl. 1, fig. 11. Albian, Holland.
Triticites grangerensis Thompson, Verville and Bissell, **390,** p. 451, pl. 40, figs. 9–15. Pennsylvanian, Utah.
—— ***hobblensis*** Thompson, Verville and Bissell, **390,** p. 460, pl. 43, figs. 4–15; pl. 44, fig. 1–3. Pennsylvanian, Utah.
—— ***provoensis*** Thompson, Verville and Bissell, **390,** p. 446, pl. 40, figs. 1–8. Pennsylvanian, Utah.
—— ***springvillensis*** Thompson, Verville and Bissell, **390,** p. 444, pl. 48, figs. 1–11. Pennsylvanian, Utah.
Trochammina antarctica Parr, **305,** p. 280, pl. 5, figs. 2–4. Recent, Antarctic.

—— *appressa* Parr, **305,** p. 277, pl. 5, figs. 6, 7. Recent, off Tasmania.
—— *callima* Loeblich and Tappan, **245,** p. 10, pl. 1, fig. 23; pl. 2, figs. 4, 5. Lower Cretaceous, Kansas.
—— *gaboensis* Parr, **305,** p. 278, pl. 5, figs. 11–13. Recent, Antarctic.
—— *hisanohamaensis* Asano, **26,** p. 159, pl. 1, fig. 8. Upper Cretaceous, Hokkaido, Japan.
—— *japonica* Ishiwada, **209,** p. 190, pl. 1, fig. 2. Recent, Japan Sea, 947 meters.
—— *lathetica* Loeblich and Tappan, **244,** p. 43, pl. 11, fig. 14. Oxfordian, South Dakota.
—— *lattai* Loeblich and Tappan, **245,** p. 11, pl. 2, fig. 6. Lower Cretaceous, Kansas.
—— *rugosa* Parr, **305,** p. 277, pl. 5, fig. 5. Recent, Antarctic.
—— *sorosa* Parr, **305,** p. 278, pl. 5, figs. 15–17. Recent, off Tasmania.
—— *spiculolega* Parr, **305,** p. 278, pl. 5, figs. 8–10. Recent, off Tasmania.
—— *tasmanica* Parr, **305,** p. 279, pl. 5, fig. 18. Recent, off Tasmania.
—— *wiesneri* Parr, **305,** p. 279, pl. 5, fig. 14. Recent, Antarctic. For: *Trochammina inflata* (Montagu) in Wiesner, 1931, Deutsche Südpolar-Exped., vol. 20, p. 111, pl. 17, fig. 201.
Turrispirillina depressa Parr, **305,** p. 351, pl. 13, figs. 17, 18. Recent, off Tasmania.
—— *spirella* Loeblich and Tappan, **246,** p. 16, pl. 1, fig. 41. Callovian, Montana. For: *Cornuspira orbicula* (Terquem and Berthelin) in: Sandidge, 1933, Amer. Midland Natural., vol. 14, p. 178, pl. 1, fig. 14.
Uvigerina akitaensis Asano, **30,** p. 14, text figs. 60–62. Pliocene, Japan.
—— *bassensis* Parr, **305,** p. 340, pl. 12, figs. 19, 20. Recent, off Tasmania.
—— *foxenensis* Bramlette, **67,** p. 59, pl. 23, fig. 16. Miocene, California.
—— *schencki* Asano, **30,** p. 17, text figs. 74, 75. Pliocene, Japan.
—— *tenuipustulata* van Voorthuysen, **411,** p. 60, pl. 2, fig. 13; text fig. 2. Middle Miocene, Holland.
Vaginulina barba Lalicker, **231,** p. 16, pl. 2, fig. 10. Bathonian, Montana.
—— *cataulaca* Loeblich and Tappan, **244,** p. 54, pl. 14, figs. 22, 23. Oxfordian, South Dakota.
—— *cetra* Lalicker, **231,** p. 17, pl. 3, fig. 5. Bathonian, Montana.
—— *compsa* Loeblich and Tappan, **244,** p. 55, pl. 14, figs. 15–19. Oxfordian, South Dakota.
—— *eichenbergi* ten Dam, **120,** p. 36, pl. 3, fig. 2. Albian, Holland. For: *Vaginulina species* Eichenberg, 1933, Jahrber. Niedersächs. Geol. Ver., p. 12, pl. 5, fig. 3.
—— *exilis* Cushman and McCulloch, **112,** p. 327, p. 42, figs. 14–21. Recent, Pacific, Galapagos, 45 fathoms.
—— *formosula* Loeblich and Tappan, **244,** p. 55, pl. 14, fig. 12. Oxfordian, South Dakota.
—— *inflata* Parr, **305,** p. 327, pl. 11, figs. 21, 22. Recent, Antarctic.
—— *inspissata* Loeblich and Tappan, **244,** p. 55, pl. 14, figs. 24, 25. Oxfordian, South Dakota.
—— *ischyra* Loeblich and Tappan, **246,** p. 56, pl. 14, fig. 20. Oxfordian, South Dakota.
—— *lancea* Lalicker, **231,** p. 16, pl. 3, fig. 3. Bathonian, Montana.
—— *lechriosa* Loeblich and Tappan, **244,** p. 56, pl. 14, fig. 21. Oxfordian, South Dakota.
—— *mariei* Khan, **221,** p. 270, pl. 1, fig. 16. Lower Gault, England. For: *Citharina cf. discors* Koch in Marie, 1938, Soc. géol. France, Bull., (5), vol. 8, p. 96, pl. 8, fig. 10.
—— *mecyna* Loeblich and Tappan, **246,** p. 13, pl. 1, fig. 38. Callovian, Montana.
—— *pala* Lalicker, **231,** p. 17, pl. 3, fig. 4. Bathonian, Montana.
—— *pseudodiscors* Khan, **221,** p. 271, pl. 1, figs. 13, 14. Lower Gault, England. For: *Vaginulina discors* (Koch) in Chapman, 1894, Jour. Roy. Micr. Soc. London, p. 426, pl. 8, fig. 13.
—— —— —— var. *semiornata* Khan, **221,** p. 272, pl. 1, fig. 15. Lower Gault, England.
—— *subelegans* Parr, **305,** p. 326, pl. 11, fig. 20. Recent, Antarctic. For: *Vaginulina elegans* d'Orbigny in Cushman, 1933, U. S. Nat. Mus. Bull. 161, pt. 2, p. 16, pl. 3, figs. 9, 10.
Vaginulinopsis ectypa Loeblich and Tappan, **244,** p. 46, pl. 12, figs. 17–20. Oxfordian, South Dakota.
—— *enodis* Loeblich and Tappan, **244,** p. 46, pl. 12, figs. 11–16. Oxfordian, South Dakota.
—— *epicharis* Loeblich and Tappan, **244,** p. 47, pl. 12, figs. 21–23. Oxfordian, South Dakota.
—— *eritheles* Loeblich and Tappan, **246,** p. 9, pl. 1, figs. 9–13. Callovian, Wyoming. For: *Marginulina sp. ?* Wickenden, 1933, Trans. Roy. Soc. Canada, (3), sect. 4, vol. 27, p. 163, pl. 1, fig. 12.
—— *procelata* Parr, **305,** p. 324, pl. 11, fig. 15. Recent, off Tasmania.
—— *pseudoscitula* ten Dam and Sigal, **121,** p. 35, pl. 2, fig. 17. Dano-Montian, Algeria. For: *Cristellaria scitula* Berthelin in Plummer, 1926 Univ. Texas Bull. 2644, p. 100, pl. 7, fig. 5; for: *Marginulina cf. scitula* (Berthelin) in Cushman, 1940, Contr. Cushman Lab. Foram. Research, vol. 16, p. 56, pl. 9, figs. 21, 22; for same species in Cushman and Renz, 1942, loc. cit., vol. 18, p. 5, pl. 1, fig. 7; and for same species in Cushman and Todd, 1942, loc. cit., vol. 18, p. 27, pl. 5, fig. 9.
—— *sublegumen* Parr, **305,** p. 325, pl. 11, fig. 18. Recent, Antarctic. For: *Vaginulina legumen* (Linne) in Brady, 1884, Challenger Repts., Zool., vol. 9, p. 530, pl. 46, fig. 13, 14 (not fig. 15).
—— *tasmanica* Parr, **305,** p. 324, pl. 11, figs. 13, 14. Recent, off Tasmania.
Valvulineria esnehensis Nakkady, **281,** p. 689, pl. 90, figs. 11–13. Basal Paleocene, Egypt.
—— *oveyi* Khan, **221,** p. 274, pl. 2, figs. 8–11. Lower Gault, England.
—— *parva* Khan, **221,** p. 275, pl. 2, figs. 12–14, 19. Lower Gault, England. For: *Placentula nitida* (Reuss) in Berthelin, 1880, Soc. géol. France, Mém., (3), vol. 1, p. 69, pl. 4, fig. 11. (Note: This species in Berthelin has been renamed *Valvulineria gracillima* ten Dam, 1947); and for: *Rotalia soldanii* d'Orbigny var. *nitida* Reuss in Chapman, 1898, Jour. Roy. Micr. Soc. London, p. 9, pl. 2, fig. 2.

—— *polita* Parr, **305,** p. 359, pl. 14, figs. 13–15. Recent, off Tasmania.

—— *porifera* Parr, **305,** p. 359, pl. 15, figs. 1, 2. Recent, off Western Australia, 62 meters.

Ventilabrella compressa van der Sluis, **357,** p. 20, pl. 1, fig. 1, Upper Cretaceous Seran (Ceram), Indonesia.

VENTROLAMINA gen. nov. Weynschenk, **418,** p. 17. A new genus of the new family Ventrolaminidae, ut infra. Genotype: *Ventrolamina cribrans* Weynschenk, 1950, ut infra. Jurassic (uppermost Dogger and Malm).

—— *cribrans* Weynschenk, **418,** p. 17, pl. 3, figs. 22–25; text figs. 2–4. Upper Jurassic, Tirol, Austria.

Ventrolaminidae new family, Weynschenk, **418,** p. 17. Includes genus *Ventrolamina* Weynschenk, 1950, ut supra. Uppermost Dogger and Malm.

Verbeekina americana Thompson, Wheeler and Danner, **391,** p. 57, pl. 5, figs. 1–6. Permian, Washington.

—— *parvula* Douglas, **131,** p. 38, pl. 5, figs. 8, 9. Middle Permian, Iran.

Verneuilina luxorensis Nakkady, **281,** p. 683, pl. 89, figs. 6, 7. Paleocene, Egypt. (no type locality given).

—— *subeocaena* Wick, **421,** p. 12, pl. 1, figs. 32–46. Lower Eocene, North Germany.

Verneuilinoides kansasensis Loeblich and Tappan, **245,** p. 10, pl. 2, figs. 1, 2. Lower Cretaceous, Kansas.

—— *tryphera* Loeblich and Tappan, **244,** p. 42, pl. 11, fig. 16. Oxfordian, South Dakota.

Virgulina californiensis Cushman, 1925, var. *purisima* Bramlette, **67,** p. 58, pl. 23, figs. 20, 25. Miocene, California. (Note: the correct spelling for the varietal name is "*purissima*").

—— *rotundata* Parr, **305,** p. 337, pl. 12, fig. 14. Recent, off Tasmania. For: *Virgulina subsquamosa* Egger in Brady, 1884, Challenger Repts., Zool., vol. 9, pl. 52, figs. 10 and 11 only (not figs. 7–9).

—— *viscidus* Khan, **221,** p. 273, pl. 2, figs. 3–5. Lower Gault, England.

VOLVOTEXTULARIA gen. nov. G. and H. Termier, **372,** p. 39. A new genus of the family Textulariidae. Genotype: *Volvotextularia polymorpha* G. and H. Termier, 1950, ut infra. Westphalian.

—— *polymorpha* G. and H. Termier, **372,** p. 39, pl. 1, figs. 11–13. Westphalian, Morocco.

Vulvulina gracillima ten Dam and Sigal, **121,** p. 31, pl. 2, fig. 1. Dano-Montian, Algeria.

Waeringella bailkeyi Thompson, Verville and Bissell, **390,** p. 438, pl. 49, figs. 1–5. Pennsylvanian, Utah.

Webbinella rugosa ten Dam, **120,** p. 5, pl. 1, figs. 1. Albian, Holland.

Zeauvigerina childi Thomas, **386,** p. 295, pl. 1, fig. 8. Upper Eocene, S.W. Iran.

—— *iranica* Thomas, **386,** p. 293, pl. 1, fig. 7. Upper Eocene, S.W. Iran.

—— *khuzistanica* Thomas, **386,** p. 296, pl. 1, fig. 9. Lower Oligocene, S.W. Iran.

NOMINA NOVA 1950

The following new names have been proposed during 1950:

Ammobaculites parvispira ten Dam, **120,** p. 10, pl. 1, fig. 8. Albian, Holland, new name for: *Haplophragmium aequale* Chapman, 1892 (non Roemer, 1841), Roy. Micr. Soc. London, Jour., vol. 12, p. 323, pl. 6, figs. 1–3.

Ammodiscus diminutivus Dunn in Thalmann, **373,** p. 41. New name for: *Ammodiscus minutus* Dunn, 1942, Jour. Paleont., vol. 16, p. 339, pl. 44, fig. 28, Upper Silurian, Missouri, on account of homonymy with *Ammodiscus minutus* Paalzow, 1932, and with *Ammodiscus exsertus* Cushman, 1910, var. *minutus* Ireland, 1939.

Anomalina berthelini ten Dam, **120,** p. 56, pl. 4, fig. 9. Albian, Holland. New name for: *Anomalina complanata* Berthelin, 1880, (non Reuss, 1851), Soc. géol. France, Mém., (3), vol. 1, p. 66, pl. 4, figs. 12, 13. (Note: ten Dam's new name is preoccupied by *Anomalina berthelini* Keller, 1935, ut infra: Homonyma 1950.)

Bathysiphon neapolitanum Hofker in Thalmann, **373,** p. 41. New name for: *Bathysiphon minutum* Hofker, 1932, Staz. Zool. Napoli, Pubbl., vol. 12, p. 70, text fig. 4, Recent, Gulf of Naples, on account of homonymy with *Bathysiphon minuta* Pearcey, 1900.

BERMUDEZELLA Thalmann, **382,** p. 224. New name for *Carpenterella* Bermudez, 1949, Spec. Publ. 25, Cushman Labor. Foram. Research, p. 313, family Rupertiidae, Middle Oligocene, on account of homonymy with *Carpenterella* Collenette, 1933, Lepidoptera.

Bolivina dentilineata Bandy in Thalmann, **373,** p. 41. New name for: *Bolivina denticulata* Bandy, 1949. Bull. Amer. Paleont., vol. 32, Nr. 131, p. 126, pl. 25, fig. 3, Eocene, Alabama, on account of homonymy with *Bolivina granti* Rankin, 1934, var. *denticulata* Cushman and Stevenson, 1949.

—— *polonica* Bieda in Thalmann, **373,** p. 41. New name for: *Bolivina hirsuta* Bieda, 1936, Ann. Soc. géol. Pologne, vol. 12, p. 264, pl. 8, figs. 1, 2, Miocene, Poland, on account of homonymy with *Bolivina hirsuta* Rhumbler, 1911.

—— *robusta* Brady, 1881, var. *indonesiensis* Boomgaart in Thalmann, **373,** p. 42. New name for: *Bolivina robusta pacifica* Boomgaart, 1949, Proefschr. Univ. Utrecht, p. 112, pl. 12, fig. 3, Pliocene, Java, on account of homonymy with *Bolivina acerosa* Cushman, 1936, var. *pacifica* Cushman and McCulloch, 1942.

—— *rukasi* Hussey in Thalmann, **373,** p. 42. New name for: *Bolivina striata* Hussey, 1949, Jour. Paleont., vol. 23, p. 134, pl. 27, figs. 18, 19, Middle Eocene, Louisiana, on account of homonymy with *Bolivina hungarica* (Vadasz, 1910) var. *striata* (Vadasz, 1910).

Cassidulina neocarinata Thalmann, **373,** p. 44. New name for: *Cassidulina laevigata* d'Orbigny var. *carinata* Cushman, 1922, U. S. Nat. Mus. Bull. 104, pt. 3, p. 124, pl. 25, figs. 6, 7. Recent, off Florida, on account of homonymy

with *Cassidulina laevigata* d'Orbigny var. *carinata* Silvestri, 1896.

Cibicides subtenuissimus (Nuttall, 1928) var. *nipeensis* Keijzer in Thalmann, **373,** p. 42. New name for: *Cibicides subtenuissimus* (Nuttall) var. *concava* Keijzer, 1945, Profeschr. Univ. Utrecht, p. 208, pl. 4, fig. 61, Oligo-Miocene, Cuba, on account of homonymy with *Cibicides concavus* Tolmachoff, 1934, and *Cibicides concavus* Dorn in LeRoy, 1941.

COSCINOPHRAGMA Thalmann, **378,** p. 221. New name for: *Polyphragma* Reuss, 1871, Akad. Wiss. Wien, Sitzber., vol. 64, Abth. 1, p. 277, on account of homonymy with *Polyphragma* Quatrefages, 1865, of the Annelidae. Upper Cretaceous.

Discorbis parri Thalmann, **380,** p. 22; new name for: *Discorbis umbonifer* Parr, **305,** p. 353, pl. 13, fig. 22, Recent, off Tasmania, on account of homonymy with *Discorbina umbonifera* Schwager, 1883.

Dorothia javana Boomgaart in Thalmann, **373,** p. 42. For: *Dorothia rotunda* Boomgaart, 1949, Proefschr. Univ. Utrecht, p. 60, pl. 5, fig. 4, Mio-Pliocene, Java, on account of homonymy with *Dorothia rotunda* (Chapman, 1902).

Elphidium micrograniulosum Galloway and Wissler in Thalmann, **380,** p. 222. For: *Elphidium granulosum* (Galloway and Wissler, 1927, olim: Themeon), Jour. Paleont., vol. 1, p. 193, Pleistocene, California, on account of homonymy with *Elphidium macellum* (Fichtel and Moll) var. *granulosum* Sidebottom, 1909.

—— *sagrai* (d'Orbigny, 1839) var. *percrassum* Galloway and Heminway in Thalmann, **380,** p. 222. New name for: *Elphidium sagrai crassum* Galloway and Heminway, 1941, New York Acad. Sci., Sci. Survey Porto Rico etc., vol. 3, pt. 4, p. 366, pl. 15, fig. 1, a homonym of *Elphidium crispum* (Linné) var. *crassa* (Mobius, 1880).

—— *terquemianum* Y. LeCalvez, **235,** p. 56, pl. 4, figs. 60, 61. Lutetian, France; new name for *Polystomella laminata* Terquem, 1882, Mém. Soc. géol. France, (3), vol. 2, p. 24, pl. 2, fig. 24.

Entosolenia bodjonegoroensis Boomgaart in Thalmann, **373,** p. 42. New name for: *Entosolenia iota* Boomgaart, 1949, Proefschr. Univ. Utrecht, p. 109, pl. 11, fig. 7, Mio-Pliocene, Java, on account of homonymy with *Entosolenia iota* Cushman, 1923.

Eponides abatissae (Selli, 1944) var. *greigi* Petters and Gandolfi, **307,** p. 18. New name for: *Eponides abatissae multicameratus* Petters and Gandolfi, 1948, Riv. Ital. Pal., vol. 54, fasc. 3, p. 7, Oligocene, Italy, on account of homonymy with *Eponides multicameratus* Kleinpell, 1938.

Fissurina alveolata (Brady, 1884) var. *semisculpta* Parr, **305,** p. 307, Recent, Antarctic; new name for: *Lagena auriculata* Brady var. *substriata* Brady, 1881 (non Williamson, 1848), Quart. Jour. Micr. Sci., vol. 21, p. 61.

Frondicularia simplissima ten Dam, **120,** p. 33, pl. 2, fig. 27. Albian, Holland. New name for *Frondicularia archiaciana* Burrows, Sherborn and Bailey, 1890, (non d'Orbigny, 1840), Jour. Roy. Micr. Soc. London, (2), vol. 10, p. 558, pl. 10, fig. 6. (Note: cave *Frondicularia simplicissima* ten Dam, 1946).

Gaudryina glabrata Cushman, 1937, var. *papillata* Galloway and Heminway, in Thalmann, **380,** p. 222. Upper Oligocene, Porto Rico. New name for *Gaudryina glabrata maxima* Galloway and Heminway, 1941, New York Acad. Sci., Sci. Surv. Porto Rico, etc., vol. 3, pt. 4, p. 323, pl. 7, fig. 2, on account of homonymy with *Gaudryina baccata* Schwager var. *maxima* Egger, 1893.

Lagena striata (d'Orbigny, 1839) var. *wiesneri* Parr, **305,** p. 301. Recent, Antarctic. New name for: *Lagena striata interrupta* Wiesner, 1931, (non Williamson, 1848), Deutsche Südpolar-Exped., vol. 20, p. 119, pl. 18, fig. 213.

—— *sulcata* (Walker and Jacob, 1798) var. *spicata* Cushman and McCulloch, **112,** p. 360, pl. 48, figs. 3–7. Recent, Pacific. New name for: *Lagena sulcata*, apiculate forms, Brady, 1884, Rep. Voy. Challenger, Zool., vol. 9, pl. 58, figs. 4, and ?17.

Lituotuba navetensis Cushman and H. H. Renz, **321,** p. 46, Eocene, Trinidad, B.W.I. New name for: *Lituotuba eocenica* Cushman and H. H. Renz, 1948, Spec. Publ. 24, Cushman Lab. Foram. Research, p. 7, pl. 1, figs. 20, 21, a homonym of: *Lituotuba (?) eocenica* Yabe, 1921.

Nodosaria balaniformis Hussey, in Thalmann, **373,** p. 42. New name for: *Nodosaria primitiva* Hussey, 1943, Jour. Paleont., vol. 17, p. 165, pl. 26, fig. 1, Eocene, Louisiana, a homonym of *Nodosaria primitiva* Kübler and Zwingli, 1866.

—— *bermudezi* Payard in Thalmann, **373,** p. 42. A new name for: *Nodosaria tenuistriata* Payard, 1947, Thesis Univ. Paris, p. 169, pl. 2, fig. 13, Upper Lias, France, a homonym of: *Nodosaria tenuistriata* Franke, 1925.

—— *lamnulifera* Boomgaart, in Thalmann, **373,** p. 42. New name for: *Nodosaria bradyi* Boomgaart, Proefschr. Univ. Utrecht, p. 79, pl. 6, fig. 11, Pliocene, Java, a homonym of *Nodosaria bradyi* (Spandel, 1901).

—— *mitis* (Terquem and Berthelin, 1875) var. *pictaviensis* Payard, in Thalmann, **373,** p. 42. New name for: *Nodosaria mitis conica* Payard, Thesis Univ. Paris, p. 171, pl. 2, fig. 19, Upper Lias, France, a homonym of *Nodosaria conica* Neugeboren, 1852.

—— *thalmanni* Payard in Thalmann, **373,** p. 42. New name for: *Nodosaria paucicosta* Payard, loc. cit., p. 169, pl. 2, fig. 16. Upper Lias, France, a homonym of *Nodosaria paucicosta* Roemer, 1841.

Nubecularia triloculina ten Dam, **120,** p. 19, pl. 1, fig. 22. Albian, Holland. New name for *Nubecularia lucifuga* Jones, Parker and Brady, 1860, (non Defrance, 1825), Geol. Soc. London, Quart. Jour., vol. 16, p. 455, pl. 20, figs. 52–56. (Note: Same name introduced as a nomen nudum by ten Dam in 1948, Jour. Paleont., vol. 23, p. 178, based on same synony-

my, but for a specimen from Middle Neocomian of Holland).

Nummulites (*Nummulites*) *caraibensis* M. de Cizancourt in Thalmann, **373,** p. 43. New name for: *Nummulites antillea* (Hanzawa, olim: *Pellatispirella*, 1937), in de Cizancourt, Bull. Soc. géol. France, (5), vol. 18, p. 667, Eocene, Haiti, a homonym of *Nummulites antillea* Cushman, 1919.

PARRELLINA Thalmann, **383,** p. 224. A new name for *Elphidioides* Parr, **305,** p. 373, a homonym of *Elphidioides* Cushman, 1945. Lower Pliocene and Recent. Genotype: *Polystomella imperatrix* Brady, 1884, Rept. Sci. Voy. Challenger, Zool., vol. 9, p. 738, pl. 110, figs. 13–15.

PEALERINA Lalicker in Thalmann, **373,** p. 43, and Lalicker, 1951, Jour. Paleont., vol. 25, p. 237. New name for *Ellisina* Lalicker, 1950, 231, p. 19, on account of homonymy with *Ellisina* Norman, 1903, a bryozoan. Upper Jurassic.

Planulina palmerana Garrett, **166,** p. 506. New name for: *Planulina palmerae* Garrett, 1942, Jour. Paleont., vol. 16, p. 463, pl. 70, figs. 3, 4. Miocene, Texas, a homonym of *Planulina palmerae* van Bellen, 1941.

Proteonina ? devexa Dunn in Thalmann, **373,** p. 43. New name for: *Proteonina ? ovata* Dunn, 1942, Jour. Paleont., vol., 16, p. 327, pl. 43, fig. 6. Lower Silurian, Illinois, a homonym of *Proteonina ovata* Cushman, 1910.

Psammosphaera compressa Dunn in Thalmann, **373,** p. 43. New name for: *Psammosphaera subsphaerica* Dunn, 1942, loc. cit., p. 321, pl. 42, fig. 13, Upper Silurian, Mississippi, on account of homonymy with *Psammosphaera subsphaerica* Stewart and Priddy, 1941.

Pseudocitharina fasciata Payard, 1947, var. *pictaviensis* Payard in Thalmann, **373,** p. 43. New name for: *Pseudocitharina fasciata aalense* Payard, 1947, Thesis Univ. Paris, p. 142, pl. 5, figs. 11, 12. Upper Liassic, France, a homonym of *Pseudocitharina longuemari* (Terquem) var. *aalense* Payard, 1947.

Quinqueloculina adelaidensis Howchin and Parr, 1938, var. *nipeensis* Keijzer in Thalmann, **373,** p. 43. New name for: *Quinqueloculina adelaidensis minuta* Keijzer, 1945, Proefschr. Univ. Utrecht, p. 193, pl. 2, fig. 21, Oligo-Miocene, Cuba, a homonym of *Quinqueloculina minuta* Beck, 1943.

—— *neostriatula* Thalmann, **373,** p. 45. New name for: *Quinqueloculina striatula* Cushman, 1932, U. S. Nat. Mus. Bull. 161, p. 27, pl. 7, figs. 3, 4, a homonym of *Quinqueloculina striatula* Deshayes, 1831.

Rotalia avalonensis Natland, **282,** p. 30, pl. 8, fig. 4, Pleistocene, Lower California, Mexico. New name for: *Rotalia depressa* Natland, 1938, Scripps Inst. Oceanogr., Bull. Techn. Ser., vol. 4, No. 5, p. 147, pl. 5, fig. 15., a homonym of *Rotalia depressa* von Münster, 1838.

Siphonina obesa van Bellen in Thalmann, **373,** p. 43. New name for: *Siphonina cubensis* van Bellen, 1941, Proc. Nederl. Akad. Wetensch., vol. 44, p. 1144, figs. 1–3, Lower Oligocene, Cuba, a homonym of *Siphonina advena* Cushman var. *cubensis* Cushman and Bermudez, 1937. (Note: Van Bellen's homonym was placed into synonymy of *Siphonina nuda* Cushman and Bermudez, 1934, by Keijzer, 1942, Proc. Nederl. Akad. Wetensch., vol. 45, p. 608).

Spirophthalmidium gaultinum ten Dam, **120,** p. 18, pl. 1, fig. 21. Albian, Holland. New name for: *Spiroloculina nitida* Chapman, 1898, (non d'Orbigny, 1826), Jour. Roy. Micro. Sco. London, vol. 18, p. 11, pl. 22, fig. 3.

Textularia neorugosa Thalmann, **373,** p. 45. New name for *Textularia rugosa* (Reuss, 1869, olim *Plecanium*), Sitzber. Akad. Wiss. Wien, vol. 59, p. 453, pl. 1, fig. 3, a homonym of *Textularia rugosa* d'Orbigny, 1826, and of Costa, 1856.

Thurammina elegans Dunn in Thalmann, **373,** p. 43. New name for: *Thurammina splendens* Dunn, 1942, Jour. Paleont., vol. 16, p. 334, pl. 43, fig. 30. Upper Silurian, Mississippi, on account of homonymy with *Thurammina splendens* Egger, 1899.

Tritaxia jongmansi Schijfsma in Thalmann, **373,** p. 43. New name for: *Tritaxia compressa* Schijfsma, 1946, Mededeel. Geol. Sticht. Haarlem, (C), vol. 5, No. 7, p. 33, pl. 1, fig. 5. Hervian (U. Cret.) Holland, a homonym of: *Tritaxia compressa* Egger, 1899.

Uvigerina hollicki Thalmann, **373,** p. 45. New name for *Uvigerina peregrina* Cushman var. *bradyana* Cushman, 1925, U. S. Nat. Mus., Bull. 100, pt. 4, p. 168, pl. 42, fig. 12, Recent, Atlantic, a homonym of *Uvigerina bradyana* Fornasini, 1900.

Vaginulina mediocarinata ten Dam, **120,** p. 36, pl. 3, fig. 3. Albian, Holland. New name for *Vaginulina strigillata* Chapman, 1894, (non Reuss, 1845, *Citharina*), Jour. Roy. Micr. Soc. London, vol. 14, pl. 423, pl. 8, figs. 3, 4.

—— *tappani* ten Dam, **120,** p. 37, pl. 3, fig. 4. Albian, Holland. New name for: *Vaginulina biochei* Berthelin var. *elongata* Eichenberg, 1935, (non Roemer, 1841), 27th Jahresber. Niedersächs. Geol. Ver., p. 26, pl. 7, fig. 4. (Note: correct spelling of new species name is "*tappanae*" in honor of Mrs. Loeblich Tappan.)

FORMS WITH NOMENCLATURA APERTA

Ammobaculites sp. Phleger and Walton, **310,** pl. 1, fig. 15. Recent, Massachusetts.

—— *sp.* Weynschenk, **418,** p. 22, pl. 2, fig. 16. Jurassic, Austria.

Ammodiscus sp. Bartenstein, **43,** p. 260, pl. 12, fig. A, Upper Carboniferous, Germany.

—— *sp.* Bartenstein, **43,** p. 260, pl. 12, fig. B. Upper Carboniferous, Germany.

—— *sp.* Phleger and Walton, **310,** pl. 1, fig. 7. Recent, Massachusetts.

—— *sp.* Phleger and Walton, **310,** pl. 1, fig. 8. Recent, Massachusetts.

—— *sp.* G. and H. Termier, **372,** p. 112, pl. 1, fig. 15. Eifelian, Morocco.

Amphistegina sp. Bronnimann, **72,** p. 252, text fig. 2. Upper Oligocene, Trinidad.

—— *sp.* Bronnimann, **72,** p. 253, text figs. 3, 5. Lower Miocene, Trinidad.
—— *sp.* Bronnimann, **72,** p. 253, text fig. 4. Lower Miocene, Trinidad.
—— *sp.* Bronnimann, **72,** p. 254, text fig. 6 Lower Miocene, Trinidad.
Angulogerina sp. 1 Ishiwada, **209,** p. 191, figs. 5, 6. Recent, Japan.
Annulocibicides sp. A Natland, **282,** p. 40, pl. 11, fig. 7. Upper Pliocene, Lower California.
Anomalina sp. van der Sluis, **357,** p. 23, pl. 2, fig. 9. Eogene, Seran.
Archais sp. 1 Henson, **190,** p. 45, pl. 7, figs. 7, 8. Upper Oligocene, Iraq.
Bathysiphon sp. Bieda, **58,** p. 174, pl. 4, figs. 4–7, 9. Eocene, Poland.
—— *sp.* Bieda, **58,** p. 176, pl. 4, fig. 8. Eocene, Poland.
Bathysiphon ? sp. Wick, **421,** p. 5, pl. 3, figs. 24–33. Paleocene, Germany.
—— *? sp.* Wick, **421,** p. 9, pl. 11, figs. 7, 8. Paleocene, Germany.
Bitubulogerina sp. Said, **331,** p. 7, pl. 1, fig. 18. Recent, Red Sea.
Boldia sp. van der Sluis, **357,** p. 21, pl. 1, fig. 6. Upper Cretaceous, Seran.
Bolivina sp. 1 van Voorthuysen, **411,** pl. 62, pl. 2, fig. 9. Pliocene, Holland.
Bulimina sp. van der Sluis, **357,** p. 22, pl. 2, fig. 6. Eogene, Seran.
—— *sp.* van Voorthuysen, **409,** pl. 1, fig. 7. Recent, Holland.
Bullopora sp. Frizzell and Anderson, **155,** p. 58, text fig. 5. Upper Cretaceous, Texas.
Camerina sp. Hagn, **180,** pl. 3, fig. 2. Reworked in Miocene, Bavaria.
—— *sp.* Hagn, **180,** pl. 4, fig. 4, Reworked in Miocene, Bavaria.
—— *sp.* Hagn, **180,** pl. 5, figs. 8, 9. Reworked in Aquitanian, Bavaria.
Cassidulina sp. 1 van Voorthuysen, **411,** p. 63, pl. 3, fig. 1. Miocene, Holland.
Cibicides sp. 1 van Voorthuysen, **410,** p. 40, pl. 2, fig. 8. Plio-Pleistocene, Holland.
—— *sp. 2* van Voorthuysen, **410,** p. 40, pl. 3, fig. 1. Plio-Pleistocene, Holland.
—— *sp. 3* van Voorthuysen, **410,** p. 40, pl. 3, fig. 2. Plio-Pleistocene, Holland.
Climacammina sp. Douglas, **131,** p. 43, pl. 4, fig. 12. Middle Permian, Iran.
Codonofusiella ? sp. A Thompson and Verville, **389,** p. 68, pl. 9, figs. 16–19. Permian, British Columbia.
Cribrostomoides (?) sp. Asano, **27,** p. 77, pl. 12, fig. 2. Miocene, Japan.
Cycloclypeus sp. Cole, **98,** p. 23, pl. 5, fig. 8. Miocene, Palau Islands.
Dentalina sp. Asano, **26,** p. 162, pl. 1, fig. 10. Upper Cretaceous, Japan.
—— *? sp.* Cushman and McCulloch, **112,** p. 317, pl. 41, fig. 18. Recent, Pacific.
—— *sp.* Hagn, **180,** pl. 1, fig. 11. Reworked in Miocene, Bavaria.
—— *sp.* Loeblich and Tappan, **245,** p. 11, pl. 2, fig. 8. Lower Cretaceous, Kansas.
Discorbis sp. A Natland, **282,** p. 28, pl. 6, fig. 10. Pliocene, Lower California.
—— *sp. B* Natland, **282,** p. 28, pl. 7, fig. 1. Pleistocene, Lower California.
—— *sp. C* Natland, **282,** p. 28, pl. 7, fig. 2. Pleistocene, Lower California.
—— *sp.* van der Sluis, **357,** p. 23, pl. 2, fig. 8. Eogene, Seran.
Eggerella sp. van der Sluis, **357,** p. 22, pl. 2, fig. 5. Eogene, Seran.
Ellipsonodosaria sp. Asano, **26,** p. 162, pl. 1, fig. 15. Upper Cretaceous, Japan.
Elphidium sp. Meneses and Gyves, **266,** p. 79, pl. 2, fig. 11. Lower Oligocene, Mexico.
—— *sp. 1* van Voorthuysen, **410,** p. 44, pl. 4, fig. 6. Plio-Pleistocene, Holland.
Enantiomorpha species ten Dam, **120,** p. 41, pl. 3, fig. 11. Albian, Holland.
Enantiovaginulina species ten Dam, **120,** p. 42, pl. 3, fig. 13. Albian, Holland.
Endothyra sp. Zeller, **434,** pl. 2, figs. 1, 3; pl. 3, figs. 1, 3, 4, 6, 7, 11, 13, 14. pl. 4, figs. 2, 3, 5, 10–14. Mississippian.
Entosolenia sp. A Natland, **282,** p. 19, pl. 5, fig. 2. Middle Pliocene, Lower California.
Eouvigerina sp. van Voorthuysen, **409,** pl. fig. 16. reworked in recent beds, Holland.
Eponides sp. A Natland, **282,** p. 30, pl. 7, fig. 11. Middle Pliocene, Lower California.
—— *sp.* van der Sluis, **357,** p. 23, pl. 2, fig. 7. Eogene, Seran.
Fissurina sp. 1, van Voorthuysen, **410,** p. 36, pl. 1, fig. 8. Plio-Pleistocene, Holland.
Frondicularia sp. Loeblich and Tappan, **244,** p. 58, pl. 16, fig. 10. Oxfordian, S. Dakota.
—— *sp. 1* van Voorthuysen, **411,** p. 58, pl. 2, fig. 4. Pliocene, Holland.
—— *sp. 1* Weynschenk, **418,** p. 13, pl. 1, fig. 4. Middle Jurassic, Austria.
Fusulina sp. A Thompson, Verville and Bissell, **390,** p. 441, pl. 57, figs. 9–14. Pennsylvanian, Utah.
Gaudryina sp. van der Sluis, **357,** p. 22, pl. 2, fig. 4. Eogene, Seran.
Globigerina sp. Hagn, **180,** pl. 3, fig. 4. Reworked in Miocene, Bavaria.
—— *sp.* Jacob and Sastri, **211,** p. 81, text fig. 9. Eocene, India.
—— *? sp.* van Voorthuysen, **410,** p. 41, pl. 3, fig. 3. Plio-Pleistocene, Holland.
Globigerinidae (indet.) Weynschenk, **418,** p. 9, pl. 1, fig. 8. Upper Lias, Austria.
Globigerinoides sp. A Natland, **282,** p. 37, pl. 10, fig. 6. No age and locality.
Globorotalia sp. van der Sluis, **357,** p. 22, pl. 1, fig. 9. Upper Cretaceous, Seran.
Globorotalites sp. Hagn, **180,** pl. 2, fig. 6. Reworked into Aquitanian, Bavaria.
Globotruncana sp. Asano, **26,** p. 162, pl. 1, fig. 5. Upper Cretaceous, Japan.
—— *sp.* Hagn, **180,** pl. 2, fig. 10. Reworked into Aquitanian, Bavaria.
—— *sp.* Hagn, **180,** pl. 3, fig. 1. Reworked into Miocene, Bavaria.
—— *aegyptiaca* Nakkady, 1950, *var. 1* Nakkady, **281,** p. 690, pl. 40, figs. 27, 28. Upper Cretaceous, Egypt.
Globulina lacrima Reuss *var. 1* A. M. Visser, **403,** p. 242, pl. 1, fig. 12, Maestrichtian, Holland.

—— —— —— *var. II* A. M. Visser, **403,** p. 242, pl. 1, fig. 11. Maestrichtian, Holland.
Glomospira sp. van der Sluis, **357,** p. 22, pl. 2, fig. 2. Eogene, Seran.
Gümbelina sp. Hagn, **180,** pl. 1, fig. 4. Reworked into Upper Miocene, Bavaria.
—— *sp.* Hagn, **180,** pl. 2, fig. 2. Reworked into Aquitanian, Bavaria.
Guttulina problema d'Orbigny *var. I* A. M. Visser, **403,** p. 239, pl. 1, fig. 13. Maestrichtian, Holland.
Gyroidina sp. Hagn, **180,** pl. 2, fig. 9. Reworked into Aquitanian, Bavaria.
Haplophragmoides sp. Asano, **24,** p. 18, pl. 3, fig. 13. Upper Cretaceous, Japan.
—— *sp.* van der Sluis, **357,** p. 22, pl. 2, fig. 3. Eogene, Seran.
Hyperammina sp. Bartenstein, **43,** p. 260, pl. 12, fig. A. Upper Carboniferous, Germany.
—— *sp.* Bartenstein, **43,** p. 260, pl. 12, fig. D. Upper Carboniferous, Germany.
—— *? sp.* Lipparini, **616,** p. 8, pl. fig. 2, 3. Oligocene, Italy.
Labrospira sp. 1 Ishiwada, **209,** p. 190, pl. fig. 1. Recent, Japan Sea.
Lagena sp. a Jacob and Sastri, **211,** p. 81, text fig. 1. Eocene, India.
—— *sp. b.* Jacob and Sastri, **211,** p. 81, text fig. 2. Eocene, India.
Lenticulina sp. Bartenstein, **43,** p. 345, pl. 3, fig. 2. Upper Oligocene, Germany.
—— *sp.* A. M. Visser, **403,** p. 223, pl. 7, fig. 6. Maestrichtian, Holland.
—— (*Vaginulinopsis*) *sp.* Bartenstein, **43,** p. 343, pl. 1, fig. 8. Upper Oligocene, Germany.
—— (——) *sp.* Bartenstein, **43,** p. 345, pl. 2, fig. 18. Upper Oligocene, Germany.
Lepidocyclina sp. Fukuta, **161,** pl. 1, fig. 4. Lower Miocene, Japan.
Lingulina sp. Loeblich and Tappan, **245,** p. 12, pl. 2, fig. 12. Lower Cretaceous, Kansas.
Loxostoma (recte: *Loxostomum*) *sp.* Accordi and Socin, **8,** p. 26, pl. 1, fig. 5. Pleistocene, Italy.
Marginulina sp. 1 van Voorthuysen, **411,** p. 57, pl. 1, figs. 16, 17. Miocene, Holland.
—— *sp. 2* van Voorthuysen, **411,** p. 57, pl. 1, fig. 19. Pliocene, Holland.
—— *sp. 3* van Voorthuysen, **411,** p. 57, pl. 1, fig. 20. Miocene, Holland.
—— *sp. 4* van Voorthuysen, **411,** p. 57, pl. 1, fig. 21. Pliocene, Holland.
Marginulinopsis sp. 1 van Voorthuysen, **411,** p. 58, pl. 1, fig. 18. Pliocene, Holland.
Marssonella sp. van Voorthuysen, **409,** pl. 2, fig. 17. Reworked into Recent, Holland.
Massilina sp. Loeblich and Tappan, **244,** p. 43, pl. 11, fig. 15. Oxfordian, S. Dakota.
Millerella sp. Minato, **270,** p. 380, text figs. 1–5. Lower Carboniferous, Manchuria.
—— *sp.* Zeller, **434,** pl. 5, figs. 10, 11, 14–17. Upper Mississippian, Illinois.
Neofusulinella ? sp. Thompson and Verville, **389,** p. 69, pl. 9, figs. 13–15. Permian, British Columbia.
Neoschwagerina sp. Thompson, Wheeler and Danner, **391,** p. 60, pl. 6, figs. 1, 2. Permian, Washington.
Nodosarella sp. van der Sluis, **357,** p. 21, pl. 1, fig. 5. Upper Cretaceous, Seran.
Nodosaria sp. Cushman and McCulloch, **112,** p. 324, pl. 41, fig. 25. Recent, Pacific.
—— *sp.* Loeblich and Tappan, **245,** p. 11, pl. 2, fig. 9. Lower Cretaceous, Kansas.
—— *sp.* van Voorthuysen, **411,** p. 57, pl. 1, fig. 15. Miocene, Holland.
Nonion sp. 1 van Voorthuysen, **410,** p. 42, pl. 3, fig. 8. Plio-Pleistocene, Holland.
—— *sp. 2* van Voorthuysen, **410,** p. 52, pl. 4, fig. 9. Plio-Pleistocene, Holland.
Nonionella sp. Jacob and Sastri, **211,** p. 81, text fig. 4. Eocene, India.
Nummulites sp. forma A Ruiz de Gaona and Colom, **329,** p. 422, fig. 18, No. 19. Eocene, Spain.
Nummulostegina ? Weynschenk, **418,** p. 20, pl. 3, fig. 27. Jurassic, Austria.
Ophthalmidiidae genus ?, species ? Weynschenk, **418,** p. 15, pl. 1, figs. 5–7. Jurassic, Austria.
Palmula sp. Bartenstein, **45,** p. 345, pl. 2, fig. 17. Upper Oligocene, Germany.
Parafusulina sp. A Thompson, and Verville, **389,** p. 70, pl. 9, figs. 8–11. Permian, British Columbia.
Peneroplis evolutus Henson, 1950, *var.?* Henson, **190,** p. 38, pl. 10, figs. 6, 8, 11. Lower Middle Miocene, S.W. Iran.
Planularia sp. A. M. Visser, **403,** p. 225, pl. 7, fig. 4. Maestrichtian, Holland.
Planulina sp. Hagn, **180,** pl. 1, fig. 13. Reworked in Upper Miocene, Bavaria.
—— *sp.* A. M. Visser, **403,** p. 288, pl. 7, fig. 15. Maestrichtian, Holland.
Planulinella alticosta (ten Dam and Reinhold, 1942) *var. 1* Sigal, **353,** p. 67, text fig. 5. Aquitanian, Bavaria.
—— —— (——) *var. 2* Sigal, **353,** p. 67, text fig. 6. Aquitanian, Bavaria.
Plectogyra sp. Zeller, **434,** pl. 1, figs. 1–9, 11; pl. 2, figs. 2, 4–22; pl. 3, figs. 10, 12, 14; pl. 4; figs. 1, 4, 6–9; pl. 5, figs. 1–9, 12, 13, 18–22. Mississippian, Iowa.
Pseudoglandulina sp. Loeblich and Tappan, **245,** p. 12, pl. 2, fig. 10. Lower Cretaceous, Kansas.
Pseudouvigerina sp. A. M. Visser, **403,** p. 256, pl. 1, fig. 15. Maestrichtian, Holland.
Quinqueloculina sp. A Natland, **282,** p. 8, pl. 3, fig. 2. Upper Pliocene, Lower California.
—— *sp. B* Natland, **282,** p. 8, pl. 3, fig. 4. Plio-Pleistocene, Lower California.
Rectobolivina sp. A Natland, **282,** p. 23, pl. 5, fig. 24. Pleistocene, Lower California.
—— *sp. B* Natland, **282,** p. 23, pl. 5, fig. 25. Pleistocene, Lower California.
Reophax sp. Phleger and Walton, **310,** pl. 1, fig. 4. Recent, Massachusetts.
—— *sp.* Said, **331,** p. 4, pl. 1, fig. 1. Recent, Red Sea.
Robulus sp. Asano, **26,** p. 160, pl. 1, fig. 16. Upper Cretaceous, Japan.
Rotalia sp. A Natland, **282,** p. 31, pl. 8, fig. 6. Pleistocene, Lower California.
Saracenaria sp. Cushman and McCulloch, **112,** p. 327, pl. 42, fig. 13. Recent, Pacific.

—— *sp.* Hagn, **180,** pl. 1, fig. 12. Reworked in Miocene, Bavaria.

Sigmomorphina sp. A. M. Visser, **403,** p. 248, pl. 3, fig. 2. Maestrichtian, Holland.

Somalina danieli Henson, 1950, *var. ?* Henson, **190,** p. 61, pl. 3, figs. 4–6. Upper Eocene, Iraq.

Sorites? sp. 1 Henson, **190,** p. 56, pl. 3, figs. 8, 9. Upper Oligocene, Iraq.

—— *sp.* Limon-Gutierrez, **240,** text fig. 9. Upper Oligocene, Mexico.

Spirillina sp. Loeblich and Tappan, **244,** p. 60, pl. 16, fig. 12. Oxfordian, S. Dakota.

Staffella sp. Douglas, **131,** p. 35, pl. 5, fig. 2. Moscovian, Baluchistan (Iran).

—— *sp.* Thompson and Verville, **389,** p. 68, pl. 9, fig. 12. Permian, British Columbia.

Textularia sp. Loeblich and Tappan, **245,** p. 9, pl. 1, fig. 28. Lower Cretaceous, Kansas.

—— *sp.* A. M. Visser, **403,** p. 215, pl. 1, fig. 5. Maestrichtian, Holland.

—— *sp. 1* van Voorthuysen, **411,** p. 54, pl. 1, fig. 1. Miocene, Holland.

Tribrachia sp. Bartenstein, **43,** p. 344, pl. 2, fig. 16. Upper Oligocene, Germany.

Triloculina sp. 1 van Voorthuysen, **411,** p. 54, pl. 1, fig. 3. Pliocene, Holland.

Triticites sp. A Thompson, Verville and Bissell, **390,** p. 462, p. 164, figs. 4–10. Pennsylvanian, Utah.

—— *sp. B* Thompson, Verville and Bissell, **390,** p. 463, pl. 64, figs. 11–19. Pennsylvanian, Utah.

Vaginulina species ten Dam, **120,** p. 38, pl. 3, fig. 6. Albian, Holland.

Vaginulinopsis sp. 1 van Voorthuysen, **411,** p. 58, pl. 1, fig. 23. Pliocene, Holland.

—— *sp. 2* van Voorthuysen, **411,** p. 58, pl. 2, fig. 1. Pliocene, Holland.

—— *sp. 3* van Voorthuysen, **411,** p. 58, pl. 2, fig. 2. Pliocene, Holland.

Valvulineria sp. A. M. Visser, **403,** p. 264, pl. 7, fig. 11. Maestrichtian, Holland.

Virgulina sp. Jacob and Sastri, **211,** p. 81, text fig. 5. Eocene, India.

Vitriwebbina sp. Loeblich and Tappan, **244,** p. 60, pl. 16, fig. 9. Oxfordian, S. Dakota.

Webbinella (?) sp. Phleger and Walton, **310,** pl. i, fig. 3. Recent, Massachusetts.

Yabeina ? n. sp. Thompson, Wheeler and Danner, **391,** p. 62, pl. 8, figs. 8–10. Permian, British Columbia.

Zeauvigerina sp. van der Sluis, **357,** p. 21, pl. 1, fig. 4. Upper Cretaceous, Seran.

HOMONYMA ERECTED DURING 1950

The following homonyms were found in the literature on the Foraminifera for the year 1950:

Anomalina berthelini ten Dam, **120,** p. 56, pl. 4, fig. 9, Albian, Holland, a new name proposed by ten Dam for *Anomalina complanata* Berthelin, 1880, (non Reuss, 1851), Mém. Soc. géol. France, (3), vol. 1, p. 66, pl. iv, figs. 12, 13. Ten Dam's new name is, however, preoccupied by Keller, 1935, Bull. Soc. Naturalistes Moscou, n.s., vol. 43, sect. géol., vol. 13, p. 552, pl. 3, figs. 25–27, Cenomanian, Donetz Basin, Russia. Since Keller erected his *Anomalina berthelini* on exactly the same reference in Berthelin, 1880, as given by ten Dam, there is no need for ten Dam to propose a new name for his *Anomalina berthelini.*

Discorbis umbonifer Parr, **305,** p. 353, pl. 13, fig. 22. Recent, off Tasmania, is preoccupied by *Discorbina umbonifera* Schwager, 1883, Palaeontogr., vol. 30, p. 126, pl. 27, fig. 14, from the Eocene of Libya. Parr's homonym has been renamed *Discorbis parri* nom. nov. Thalmann, **380,** p. 222, ut supra.

ELLISINA gen. nov. Lalicker, **231,** p. 18, a new genus of the Polymorphinidae, Genotype: *Ellisina spatula* Lalicker, **231,** p. 19, pl. 4, fig. 3, text fig. 5, Jurassic, U.S.A., is preoccupied by *Ellisina* Norman, 1903, Ann. Mag. Nat. Hist. (7), vol. 11, p. 596, a bryozoan, and has been renamed *Pealerina* Lalicker in Thalmann, **373,** p. 43.

ELPHIDIOIDES gen. nov. Parr, **305,** p. 373, a new genus of the family Nonionidae, genotype: *Polystomella imperatrix* Brady, 1884 Rept. Voy. Challenger, Zool., vol. 9, p. 738, pl. 110, figs. 13–15. Recent, is preoccupied by *Elphidioides* Cushman, 1935, Contr. Cushman Lab. Foram. Research, vol. 21, p. 7. Parr's genus-name has been changed to *PARRELLINA* Thalmann, **383,** p. 224. Lower Pliocene and Recent.

Nonion barleeanum (Williamson, 1858) var. *inflatum* van Voorthuysen, **410,** p. 41, pl. 3, fig. 6, text fig. 7, Pleistocene, Holland, is preoccupied by *Nonionina inflata* Alth, 1850, Haidinger's Naturwiss, Abhandl., vol. 3, p. 266, pl. 13, fig. 22. Van Voorthuysen, however, has assigned this species and variety to the genus *Anomalinoides* (in Lit. 411, p. 66), and, according to a letter, dated November 20, 1951, intends to change his homonym to *Anomalinoides barleeanum* (Williamson) var. *zandamae* nom. nov.

PROTOPENEROPLIS gen. nov. Hofker, **199,** p. 393. A new genus of the family Peneroplidae. Genotype: *Peneroplis senoniensis* Hofker, 1949, Inst. Roy. Sci. Nat. Belgique, Mém. No. 112, p. 41, text fig. 19. Maestrichtian, Limburg, Holland. Hofker's genus name is preoccupied by *Protopeneroplis* Weynschenk, **418,** p. 13, ut supra, with genotype: *Protopeneroplis striata* Weynschenk, 418, ut supra, from the Upper Jurassic, Austria. According to a letter, dated December 16, 1951, Hofker intends to change his homonym to *Praepeneroplis.*

PUTEOLUS gen. nov. Hofker, **199,** p. 394, a new genus of the family Peneroplidae, genotype: *Peneroplis proteus* d'Orbigny, 1839, in de la Sagra, Hist. Physique, etc. Cuba, "Foraminifères," p. 60, pl. 7, figs. 7–11, is preoccupied by *Puteolus* Monterosato, 1888, Bull. Soc. malacol. Italie, vol. 13, p. 173, a mollusk. Hofker informed the compiler by letter, dated December 16, 1951, that he intends to change his homonym to *Puteolina.*

Robulus mellahensis Nakkady, 1950, var. *obesus* Nakkady, **281,** p. 683 may become a homonym of either *Cristellaria obesa* Costa, 1857, Mem. Acc. Sci. Napoli, vol. 2, p. 121, pl. 1, fig. 7, or

of *Cristellaria obesa* Karrer, 1877, Abhandl. k. k. geol. Reichsanst., Wien, vol. 9, p. 383, pl. 16-B, fig. 40, if and when, after examination of the originals or of topotype material of Karrer and Costa, either *Cristellaria obesa* proves to be a true *Robulus*.

Spiroloculina nitida d'Orbigny, 1826, var. *dilatata* Silvestri, **354,** p. 28, an unfigured variety of brackish water habitat, Laguna Veneta, Italy, is, according to the Rules of Zoological Nomenclature, Art. 25, invalid, but would become a homonym of *Spiroloculina dilatata* d'Orbigny, 1846, Foram. Foss. Tert. Vienne, p. 271, pl. 16, fig. 16–18.

Spiroplectammina rectangularis ten Dam, 1947, var. *cretosa* ten Dam, **120,** p. 11, pl. 1, fig. 9. Albian, Holland, is preoccupied by *Spiroplectammina laevis* (Roemer, 1841) var. *cretosa* Cushman, 1932, Contr. Cushman Lab. Foram. Research, vol. 7, p. 87, pl. 11, fig. 3 from Upper Cretaceous of Texas. According to a letter, dated March 5, 1951, ten Dam intends to rename this varietal homonym: *Spiroplectammina rectangularis* ten Dam, 1947, var. *voorthuyseni* nom. nov.

Schwagerina andersoni Thompson, Wheeler and Danner, **391,** p. 55, ut supra, may possibly become a homonym of *Schwagerina anderssoni* (Schellwien, 1908, olim *Fusulina*) if the generic allocation of Grozdilova, 1938, Trans. Petrol. Geol. Prosp. Inst. Moscow-Leningrad, ser. A, fasc. 101, p. 105, pl. 2, fig. 5, proves to be correct.

NOMINA NUDA 1950

The following nomina nuda were encountered in the literature on the Foraminifera for the year 1950. If some of them might have been published in accordance with the International Rules of Nomenclature, the compiler would highly appreciate to be thus informed.

In the paper by Uchio, **399,** on p. 457, the following Japanese Middle and Upper Miocene species and varieties are cited:

Bolivina asanoi sp. nov.
Elphidium ozawai sp. nov.
Elphidiella momiyamaensis sp. nov.
Eponides tanai sp. nov.
Gaudryinella tsuchidai sp. nov.
Lagenonodosaria tubulata var. *japonica* var. nov.
Marginulina utsunomiyaensis sp. nov.
Nonion boueanum var. *multiloba* var. nov.
Plectofrondicularia niinoi sp. nov.
Rotalia tochigiensis sp. nov.
Vaginulina otukai sp. nov.

Bermudez, **56,** p. 255, cites two new genera: *EOCYCLAMMINA* and *EOLITUONELLA* from the Paleocene of Cuba, and on p. 341 a new genus and species: *GLAESNERIA bradyi* Brotzen and Bermudez from the Pliocene of Cuba.

Hofker, **198,** introduces, with figures, the following new genera: on p. 4: *DISCOPULVINULINA;* on p. 6: *CASSIDELLA* and *NEOUVIGERINA;* and on p. 14: *ASTERORO-TALIA*. In addition, on p. 12, a new species *Epistomina* (*Höglundina*) *hyalina* is figured.

Marie, **257,** p. 50, cites two new genera: *BIGENEROPOLIS* and *SCARIFICATINA*.

RECTIFICATION

H. Bolli (Trinidad) kindly drew the compiler's attention to the fact, that *Globorotalia dominicana* Bermudez in Thalmann, **373,** p. 42, is invalid, and therefore, *Globorotalia lobata* Bermudez, 1949, has to be reinstated. Thalmann confused *Globorotalites lobata* Brotzen, 1948 with *Globorotalia lobata* Bermudez, 1949. The entry *Globorotalia lobata* Brotzen in this Journal, vol. 23, 1949, p. 655, should be corrected to *Globorotalites lobata* Brotzen, 1948.

SYNONYMY 1950

According to Oinomikado, 1951, The Micropaleontologist, vol. 5, No. 2, p. 17 *Epistomaria* (*Epistomariella*) *miurensis* Kuwano, 1950, ut supra, is a synonym of *Pseudoeponides japonica* Uchio, 1950, ut supra.

INDEX TO FORAMINIFERA SUPPLEMENT FOR 1935

ENDOTHYRINA gen. nov. Mikhailov and Riabinin (1933), in Mikhailov, **439,** p. 40. A new genus of the family Ammodiscidae. Genotype: *Endothyrina typica* Mikhailov, 1935, ut infra. Lower Carboniferous. (Note: Genus name probably proposed as a nomen nudum by Mikhailov and Riabinin in 1933 or 1934; the first English description of this new genus appeared in Mikhailov, **444,** p. 59.

—— *elegans* Mikhailov, **439,** p. ?, not described, only figures on pl. I, figs. 1, 2. Lower Carboniferous, Soviet Russia.

—— *typica* Mikhailov, **439,** p. ?. No description, figs. 3 and 4 on pl. I. Lower Carboniferous, Soviet Russia.

FORSCHIA gen. nov. Mikhailov, **439,** p. 41. New genus of the family Ammodiscidae. Genotype: *Spirillina subangulata* Möller, 1879, Mém. Acad. Impér. Sci. St. Petersbourg, (7), vol. 27, No. 5, p. 27, pl. 5, fig. 3. Lower Carboniferous. (Diagnosis of new genus in English given in Mikhailov, **444,** p. 59.)

FORSCHIELLA gen. nov. Mikhailov, **439,** p. 41. New genus of the family Ammodiscidae. Genotype: *Forschiella prisca* Mikhailov, 1935, ut infra. Lower Carboniferous.

—— *prisca* Mikhailov, **439,** p. 41, pl. i, fig. 5. Lower Carboniferous, Soviet Russia. (See also: Mikhailov, **444,** p. 59, pl. 2, figs. 3, 4.)

JANISCHEWSKINA gen. nov. Mikhailov, **439** p. 40. Family not stated, but probably Endothyridae. Genotype: *Janischewskina typica* Mikhailov, 1935, ut infra. (Note: English description of this new genus, but spelled *Yanischewskina*, in Mikhailov, **444,** p. 59.)

—— *typica* Mikhailov, **439,** p. 40, pl. 1, fig. 8. Lower Carboniferous, Soviet Russia. (See also, Mikhailov, **444,** p. 59, pl. 3, fig. 6.)

Mikhailov, **438,** mentions the following forms, of which the compiler does not know whether they were ever erected in accordance with the International Rules of Zoological Nomenclature: on p. 34:

Archaediscus ulmeri n. sp.
Bradyella galloway (sic !) n. sp.
Climacammina forschi n. sp.
Endothyrina mölleri sp. n.
Cribrospira rauseri sp. n.
Forschia quasiplana sp.n.
Endothyra ingens sp. n.
MONOSTOMUM gen. nov. (would be a homonym of *Monostomum* Creplin, 1829 Vermes, Trematoda).
Nodosinella lata sp. n.
Orobias venjukowi sp. n.
Tetrataxis liquens sp. n.

on p. 35:
Climacammina gracilis Möller var. *multithyris* mut. nov.
—— *fursenko* (sic !) sp. n.
Archaediscus karreri Brady var. *horridus* n var.

on p. 39:
Palaeobigenerina schellwieni sp. n.

SUPPLEMENT FOR 1939

Bradyina galloway (sic !) Mikhailov, **444,** p. 62, pl. 3, fig. 10. Lower Carboniferous, Soviet Russia.

BRUNSIA gen. nov. Mikhailov, **444,** p. 58. A new genus of the family Ammodiscidae. Genotype: *Spirillina irregularis* v. Moeller, 1879, Mém. Acad. Impér. Sci. St. Petersbourg, (7), vol. 17, no. 5, p. 29, text fig. 8. Lower Carboniferous.

—— *pulchra* Mikhailov, **444,** p. 64, text fig. 1. Lower Carboniferous. Soviet Russia. (See also: Tchernyshewa, 1940, Bull. Soc. Natural. Moscou, vol. 48, sect. geol. vol. 18, p. 124, pl. 2, fig. 5.)

Endothyra bradyi Mikhailov, **444,** p. 62, pl. 4, figs. 1, 2. Lower Carboniferous, Russia.

Glomospira glomospiroides Mikhailov, **444,** p. 61, pl. 1, fig. 20. Lower Carboniferous, Russia.

Hemigordius ulmeri Mikhailov, **444,** p. 61, pl. 1, fig. 9. Lower Carboniferous, Russia.

MSTINIA gen. nov. Mikhailov, **444,** p. 59. A new genus of the family Ammodiscidae. Genotype: *Mstinia bulloides* Mikhailov, 1939, ut infra. Lower Carboniferous.

—— *bulloides* Mikhailov, **444,** p. 59, pl. 2, figs. 8, 9; and p. 65, fig. 4. Lower Carboniferous, Russia.

—— *fursenko* Mikhailov, **444,** p. 65, pl. 2, fig. 10, text fig. 3. Lower Carboniferous, Russia.

PERMODISCUS gen. nov. (or nomen nudum ?) Mikhailov, **444,** p. 49. According to the translation of the Russian text by P. P. Goudkoff, Mikhailov states on p. 49, when discussing the genus *Hemigordius* Schubert 1909: "the test of this genus loses its archaediscoid stage. *Nummulostegina* as treated by Lange appears to be the form to which the name *PERMODISCUS* should be assigned." [Note: The author apparently refers to one of the species of *Nummulostegina* erected by Lange in 1925 (Verhandl. Geol.-Mijnbouwk. Genootsch. Nederl. en Kol. Geol. Serie, vol. 7, pp. 271–272, pl. 4, figs. 77–78) from the Permian of Sumatra, Indonesia, but does not give a reference to a genotype chosen from Lange's *Nummulostegina padangensis, N. schuberti* or *N. parva.*]

PSEUDOENDOTHYRA gen. nov. Mikhailov, **444,** p. 60. New genus of the family Fusulinidae. Genotype: *Fusulinella struvii* v. Moeller, 1879, Mém. Acad. Impér. Sci. St. Petersbourg, (7), vol. 27, no. 5, p. 22, pl. 5, figs. 4a and 4c (not pl. 3, figs. 1a–c, or pl. 5, fig. 4-b). Lower Carboniferous.

Tuberitina maljawkini Mikhailov, **444,** pl 61, pl. 1, figs. 11, 12. Lower Carboniferous, Russia.

Valvulinella kotluvkovi Mikhailov, **444,** p. 62, pl. 4, fig. 12. Lower Carboniferous, Russia.

Mikhailov, **444,** mentions also the following nomina nuda (?): p. 49: *Permodiscus sp.;* p. 50: *Brunsia grandis* n. sp.; p. 52: *Bradyina potanini* Ven.; p. 54: *Phylitaxis* (Foraminifer ?); p. 55: *Pseudoendothyra venjukovi* sp. n. and *P. steinmanni* n. sp.

SUPPLEMENT FOR 1946

PARACYCLAMMINA gen. nov. Yabe, **458,** p. 259. No family stated. Genotype: *Loftusia bemmeleni* Silvestri, 1932, Riv. Ital. di Paleont., Anno. 38, fasc. 3–4, p. 81, pl. 3, fig. 5; pl. 4, figs. 1–4. Upper Jurassic.

SUPPLEMENT FOR 1947

Haplophragmoides cucullatus Montanaro-Gallitelli, **468,** p. 16, text fig. 1, No. 8. Upper Cretaceous, Italy.

—— (an gen. n. ?) *robulus* Montanaro-Gallitelli, **468,** p. 17, text fig. 1, Nrs. 9, 10; text fig. 2, Nr. 5. Upper Cretaceous, Italy.

Hormosina cushmani Montanaro-Gallitelli, **468,** p. 13, text fig. 1, No. 6; text fig. 2, No. 3. Upper Cretaceous, Italy.

Spiroplectammina brevis Montanaro-Gallitelli, **468,** p. 18, text fig. 1, no. 12; text fig. 2, no. 6. Upper Cretaceous, Italy.

—— *depressa* Montanaro-Gallitelli, **468,** p. 18, text fig. 1, no. 11. Upper Cretaceous, Italy.

Homonym 1947:
Proteonina difflugiformis (Brady, 1879) var. *complanata* Montanaro-Gallitelli, **468,** p. 10, text fig. 1, no. 2. Upper Cretaceous, Italy, is preoccupied by *Proteonina complanata* Franke, 1911, Jahrb. Preuss. Geol. Landesanst., vol. 32, p. 107, pl. 3, fig. 1.

Forms with nomenclatura aperta 1947:
Glomospira charoides (Parker and Jones) *var. n. ?* Montanaro-Gallitelli, **468,** p. 15, no description. Upper Cretaceous, Italy.
Reophax sp. Montanaro-Gallitelli, **468,** p. 12 text fig. 1, no. 5; text fig. 2, no. 2, Upper Cretaceous, Italy.
Spiroplectammina sp. (?) Montanaro-Gallitelli, **468,** p. 19, text fig. 1, no. 13. Upper Cretaceous, Italy.
Trochammina sp. Montanaro-Gallitelli, **468,** p. 20, text fig. 1, no. 15; text fig. 2, no. 8. Upper Cretaceous, Italy.

Nomina nuda 1947

The two nomina nuda in G. and H. Termier, **469,** p. 146: *AOUJGALIA* gen. nov. and *VOLVOTEXTULARIA* gen. nov. have been validated in 1950. (See G. and H. Termier, Lit. **372.**)

SUPPLEMENT FOR 1948

S. E. Rozovskaia, in her paper, written in Russian, on "Classification and systematic characters of the genus *Triticites*," Akad.Nauk. S.S.S.R. Doklady, new series, vol. 59, no. 9, pp. 1635–1638, 2 text figs., 1948 (No. 419 for the year 1948) subdivides the genus *Triticites* Girty, 1904, into the following new subgenera:

JIGULITES subgen. nov. Rozovskaia, loc. cit., p. 1638. Family Fusulinidae, subfamily Schwagerininae. Subgenotype: *Triticites jigulensis* Rauser. Upper part of Upper Carboniferous.

RAUSERITES subgen. nov. Rozovskaia, loc. cit., p. 1637. Family Fusulinidae, subfamily Schwagerininae. No subgenotype stated. Middle part of Upper Carboniferous. (Note: the subgenus is misprinted "*Rauserttes*.")

TRITICITES subgen. nov. Rozovskaia, loc. cit., p. 1637. Family Fusulinidae, subfamily Schwagerininae. Subgenotype: *Triticites secalicus* Say. Upper part of Upper Carboniferous.

MONTIPARUS subgen. nov. Rozovskaia, loc. cit., p. 1637. Family Fusulinidae, subfamily Schwagerininae. Subgenotype: *Triticites montiparus* Ehrenberg emend. Moeller. Basal Upper Carboniferous.

Azzaroli, 1948, Atti Soc. Toscana Sci. Nat., Mem., vol. 55, serie A, reprint p. 5, describes and figures:

Alveolina somaliensis Azzaroli, pl. 2, figs. 1–3, 5; pl. 2, figs. 8, 10, from the Ypresian of Somaliland, and also:

Verneuilina sp. Azzaroli, loc. cit., reprint p. 7, pl. 2, fig. 5. Ypresian, Somaliland.

SUPPLEMENT FOR 1949

DAIXINA gen. nov. Rozovskaia, **567,** p. 249. New genus of the family Fusulinidae. Genotype: *Daixina ruzhencevi* Rozovskaia, 1949, ut infra. Upper Carboniferous.

—— *ruzhencevi* Rozovskaia, **567,** p. 250, text fig. 1. Upper Carboniferous, Urals, Russia.

Operculina canalifera d'Archiac, 1850, subsp. *gomezi* Colom and Bauza, 529, p. 219, pl. 17, figs. 1–3 (misprinted "*gomeri*"), text figs. 1, 2. Bartonian, Spain.

Staffellinae subfam. nov. Mickluckho-Maklai, 1949, cited in Rozovskaia, **596,** p. 375.

Forms with nomenclatura aperta, 1949:

Gaudryina species Socin, **578,** p. 4, pl. 1, figs. 1, 2. Helvetian, Italy.

Hyperammina sp. Pokorny, **564,** p. 8, text fig. 1. Middle Eocene, Czechoslovaquia.

Karreriella sp. Pokorny, **564,** p. 21, text fig. 7. Middle Eocene, Czechoslovaquia.

Lagena species Socin, **578,** p. 5, pl. 1, fig. 11. Helvetian, Italy.

Marginulina species Socin, **578,** p. 5, pl. 1, fig. 22. Helvetian, Italy.

Millerella sp. Yabe, **588,** p. 165, text figs. 1–5. Upper Visean, Japan.

? Nodogenerina sp. Pokorny, **564,** p. 25, text fig. 14. Middle Eocene, Czechoslovaquia.

Nonion sp. Pokorny, **564,** p. 24, text fig. 11. Middle Eocene, Czechoslovaquia.

Nonionella sp. Pokorny, **564,** p. 24, text fig. 12. Middle Eocene, Czechoslovaquia.

Quinqueloculina species Socin, **578,** p. 4, pl. 1, fig. 6. Helvetian, Italy.

Robulus species Socin, **578,** p. 5, pl. 1, fig. 12. Helvetian, Italy.

? Siphonodosaria sp. Pokorny, **564,** p. 25, text fig. 13. Middle Eocene, Czechoslovaquia.

Uvigerina species Socin, **578,** p. 6, pl. 1, fig. 31. Helvetian, Italy.

Nomina nuda 1949:

Cassidulina nakatsuensis Nakaseko and Sawai, **558,** p. 206. Pliocene, Japan.

Plectofrondicularia nakatsuensis Nakaseko and Sawai, **558,** p. 209. Pliocene, Japan.

Rotalia sagamiensis Nakaseko and Sawai, **558,** p. 207. Pliocene, Japan.

JOURNAL OF PALEONTOLOGY, VOL. 26, NO. 2, PP. 269–271, MARCH 1952

NEWS AND COMMENT

COMMITTEE ON STRATIGRAPHIC PALEONTOLOGY

J. MARVIN WELLER, Chairman
Walker Museum, University of Chicago

THE Committee on Stratigraphic Paleontology of the National Research Council is attempting to formulate a new program of activities that will be of broad service to North American paleontologists. The Chairman of the Committee hopes that such a program will win the active support of most paleontologists and that many persons will aid in planning the Committee's work and later participate in it.

FUNCTIONS OF COMMITTEE

The fundamental objective of a National Research Council Committee of this sort is to do useful work desired by the profession. All useful and desirable projects, however, are not equally suitable for committee action and the Chairman suggests that certain practical limitations be recognized in order that the Committee may be really effective in attaining its objective.

Preliminary discussions have indicated that work of the Committee might be governed by the following general considerations:

1. The Committee should be primarily an efficient clearing house for information of interest and value to stratigraphic paleontologists. It should not attempt to solve problems in stratigraphic paleontology directly although it could encourage specialized studies by individuals or organized groups and the latter might be recognized as subcommittees if desirable.

2. The Committee's projects should in general be continuing ones whose value would not be dependent upon completion. They should not include ambitious cooperative efforts nor attempt to meet deadlines, but should be prosecuted as time and circumstances permit and the interests and activities of contributors determine.

3. The interests of the Committee should be very broad because all aspects of paleontology are important to the practical application of paleontology to stratigraphy. All paleontologists, including micropaleontologists, paleobotanists and vertebrate paleontologists can join in the work of the Committee and each group in turn is likely to benefit in proportion to its contributions. The Committee, however, should neither expect nor request individuals to undertake major activities unrelated to their interests and desires.

SUGGESTED PROJECTS

From the foregoing it should be evident that the Committee hopes to accomplish the best results by obtaining small voluntary contributions from many persons. If this system is to be successful all paleontologists must be informed of the Committee's objectives and as many as possible persuaded to participate.

The types of projects that seem to be worthwhile and possible within the limitations expressed above may be illustrated by the following which have been suggested by various persons prior to January 1st, 1952:

A. A general catalog of paleontological collections with special emphasis on those made before 1900 and containing type specimens.

Many species have been based on specimens in old-time private collections that were later acquired by museums and universities but whose present repositories are unknown to most persons. A catalog of types is not contemplated but information concerning the general nature and content of all important collections would greatly simplify the problem of locating types when they are needed for comparative study. The Committee, however, could list published catalogs of types and encourage the preparation and publication of other similar lists.

B. Notes on the precise stratigraphic and geographic sources of type specimens that are inadequately documented in the literature.

In the course of their studies many persons must have discovered information of this sort. If unrecorded it is unserviceable to others and is likely to be lost, perhaps permanently.

C. Briefly annotated lists of fossils that are of index value in restricted areas.

Many reports include faunal lists but few distinguish between common and rare species or indicate which species are zonal indices. Such information is very difficult to obtain except from actual experience or from already experienced persons.

D. Brief summaries of existing knowledge of the occurrence, distribution and paleoecology of fossil species and faunas.

Information on the paleoecology of fossils is particularly important but little can be gleaned from existing literature. Now that paleontologists are becoming increasingly interested in this subject, an effort might be made to record and circulate data of this kind as rapidly as it becomes available.

E. Preparation of sets of topotype Foraminifera for circulation.

The personnel of institutions in various areas might gradually build up collections from nearby localities for lending to other micropaleontologists. A single "lending library" would not be necessary if the locations of available collections or specimens were recorded.

COMMITTEE REPORTS

The National Research Council will prepare and circulate reports of the Committee's activities. Contributions to projects of the foregoing types might make up the major parts of these reports. Other notes and comments relating to almost any phase of paleontology, except possibly technicalities of nomenclature, which might be too brief, too incomplete or of too preliminary a nature for publication elsewhere could also be included in the reports.

Reports would be mimeographed but if necessary or desirable, maps and charts reproduced by offset printing could be included.

ILLUSTRATED AMERICAN FAUNAS

Stratigraphic correlations are based on faunal evidence which commonly consists of published faunal lists. These, however, are unsatisfactory in many ways, particularly because of uncertainty regarding their accuracy and because they rapidly become out of date. Illustrations are much more serviceable but ordinarily illustrations are only published in connection with formal systematic descriptions. The preparation of a complete paleontologic report requires much time, labor and study and when finished its publication is costly and likely to be delayed. For these reasons, and also because few persons are qualified to handle all parts of a fauna, fewer and fewer comprehensive paleontologic reports appear.

The publication of illustrations without descriptive text would do much to improve this situation. Plates could be prepared comparatively quickly and easily if exhaustive systematic study were not required. For most practical purposes, preliminary identification or identification to genera only would be sufficient. Advantages would include the following:

a) Illustrations never become out of date regardless of how they may be identified or named.

b) A comprehensive and permanent record of faunas and their occurrences could be built up.

c) Stratigraphic paleontologists could make faunal comparisons quickly, easily and comparatively accurately. If further information were required, specimens could be borrowed for examination.

d) Systematic paleontologists would be furnished with much information regarding variability and both stratigraphic and geographic occurrences.

e) Such illustrations would be very useful to field geologists not well versed in paleontology and to paleontologists collecting in unfamiliar areas.

f) Illustrations could be prepared by good advanced or graduate students under proper supervision or by more experienced paleontologists interested in particular faunas.

g) The prospect of showy, prompt and useful publications might attract more students to paleontology. The illustrations might be part of an individual research project or a master's thesis.

h) Such illustrations might relieve the

Journal of Paleontology of some publication pressure. If a few species in a fauna were new or especially interesting they could be made the subject of a short paper to be published without further illustrations and there would be no necessity to redescribe well-known forms.

i) The temptation to name dubious new species on the basis of inadequate data would be reduced.

j) Costs would be comparatively low because there would be no descriptive text. Judged on the basis of the Journal of Paleontology, plates would cost less than two cents per copy in an edition of 1500.

The faunas to be illustrated should be closely zoned stratigraphically and special attention should be paid to facies variations so that mixing of faunas on either a time or an ecological basis would be avoided. Ordinarily a series of plates would illustrate a complete fauna collected at one or several closely similar and geographically related localities. The only accompanying text would be a sufficiently detailed general section to pin-point the specimens stratigraphically, a brief description of lithology and other information regarding facies and geographic location data. Identifications, magnifications and relative abundance could be indicated directly on the plates so that explanations would be unnecessary.

This is a much more ambitious project than any of the others listed above but it does not demand concerted efforts or involve deadlines. It might develop into an outstanding accomplishment of the Committee. Much careful planning would be required, however, and as yet details regarding the plates, their size and method of reproduction have not been considered and means of publication have not been investigated. The plates could not be issued with the Committee's reports and probably would require the initiation of a new publication series of some sort that should be made self-supporting. This seems possible if an adequate revolving fund could be obtained to start it off.

AN APPEAL

Success or failure of the Committee on Stratigraphic Paleontology in the fields of activity suggested above will depend entirely upon the active cooperation of American paleontologists. The Chairman, therefore, urges all paleontologists in the United States, Canada and Mexico to send him their comments and suggestions concerning the proposed program and also ideas as to other useful and practicable activities that might be undertaken. If the response to this appeal suggests that the Committee can be successful in setting up and carrying out a worthwhile program, an organization suitable to its operation will be formed and work on its projects will be started as soon as possible.

At the very least, the Chairman urges each active paleontologist to send him a postcard with name, address and notations regarding special fields of interest and current research activities that will form the basis for a classified directory of American paleontologists.

JOURNAL OF PALEONTOLOGY, VOL. 26, NO. 2, PP. 272–274, 2 TEXT FIGS., MARCH 1952

PALEONTOLOGICAL NOTE

THE HYPOSTOMA OF *PAGETIA**

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AUSTRALIAN PAGETIAE

Pagetia significans (Etheridge), redescribed by Whitehouse (1936), and some allied species are well represented in Cambrian collections from the Northern Territory of Australia obtained during the years 1947 to 1949 by members of the Bureau of Mineral Resources. They are being studied by the writer at the present time.

These fossils occur most commonly in chert containing abundant sponge spicules. Complete specimens of *Pagetia* have been obtained which show several previously undescribed features. The most important of these are the doublure with terraced lines, the schizochroal eyes, and the hypostoma, which is preserved in its natural position in some specimens. Also a multitude of immature specimens shows the ontogenetic development of these fossils.

A comparison of these features with those of other eodiscids, particularly the type species of *Pagetia*, *P. bootes* Walcott, is desirable because Kobayashi in 1944 proposed a new subgenus, *Eopagetia*, with *Pagetia significans* as its type. Incidentally, Kobayashi's interpretation of the structure of the latter species is quite erroneous.

PAGETIA BOOTES WALCOTT

The paleontological collection of the Geological Museum at the University of Adelaide, South Australia, contains a piece of black shale (No. 3182) with seven complete specimens of *Pagetia bootes*. It is labelled Middle Cambrian, Burgess Pass, near Field, British Columbia and is marked with a circular green sticker bearing the number 35K. Dr. Franco Rasetti has furnished the information in a letter that "all material from the Burgess shale in the United States National Museum bears the locality number 35K. on a green label." There can be no doubt that these specimens are topotypes of Walcott's species. By courtesy of Sir Douglas Mawson, Professor of Geology of the University of Adelaide, this piece of shale was sent to the Bureau of Mineral Resources for study and description.

The specimens are casts and molds and the tests are not preserved. The internal cavities of the terminal pygidial spines and the articulating half-rings of the pygidia and thoracic segments are filled with pyrite. The hypostomas of two specimens are indicated by pyrite casts of the subglabellar cavities. Distortion is negligible.

THE HYPOSTOMA

The hypostoma of *Pagetia bootes* is an unforked plate with concave lateral and posterior borders. The posterior margin is slightly angular. A pair of shallow furrows extends along the lateral margins. A pair of maculae are indicated by shallow depressions at the posterolateral border. The hypostoma is distinctly convex and perhaps subangular along the median line. The anterolateral angles are short and spine-like and probably were located beneath the junctions of the ocular ridges with the dorsal furrow. These are all normal features of a trilobite hypostoma. Probably the hypostoma was connected with the doublure by a wide rostral plate.

SYSTEMATIC POSITION OF PAGETIA

Many authors have stated that the dorsal shield of *Pagetia* is structurally similar to that of conventional Cambrian trilobites. The hypostoma of *Pagetia* is now known also to be essentially identical. *Pagetia* is undoubtedly a true trilobite.

Eodiscus has been correctly interpreted as a blind *Pagetia* and the recognition of a

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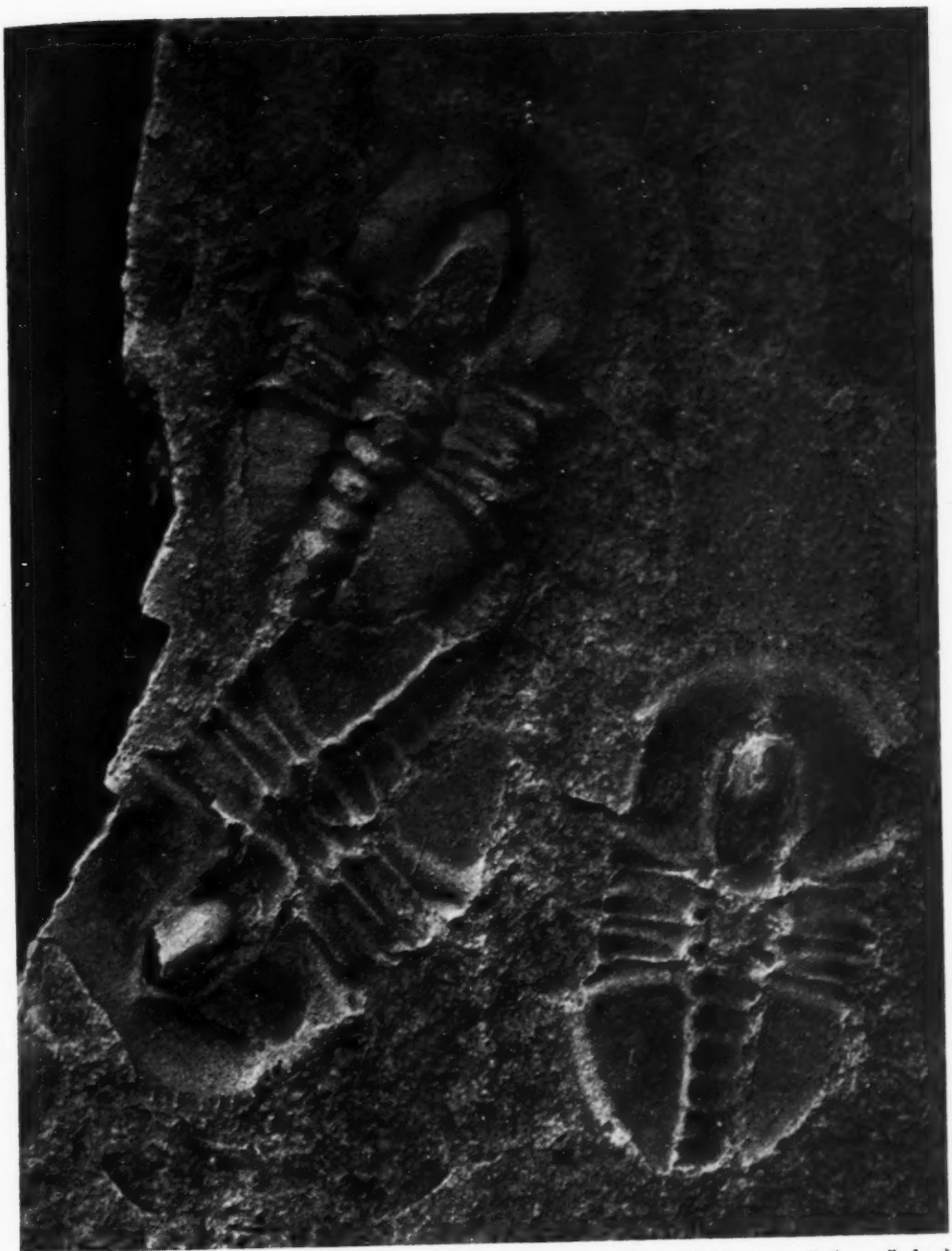

FIG. 1—*Pagetia bootes* Walcott, approximately ×9. Three complete shields, two of them (below) with hypostoma *in situ*, from Middle Cambrian Burgess shale, Burgess Pass, near Field, British Columbia. Adelaide University Museum 3182.

single family, the Eodiscidae Gürich (Raymond, 1913), is amply justified (R. & E. Richter, 1941).

The Richters have united the Eodiscidae and the Agnostidae in a single trilobite superfamily, the Agnostidea Salter, and this view has been accepted by Westergaard (1946).

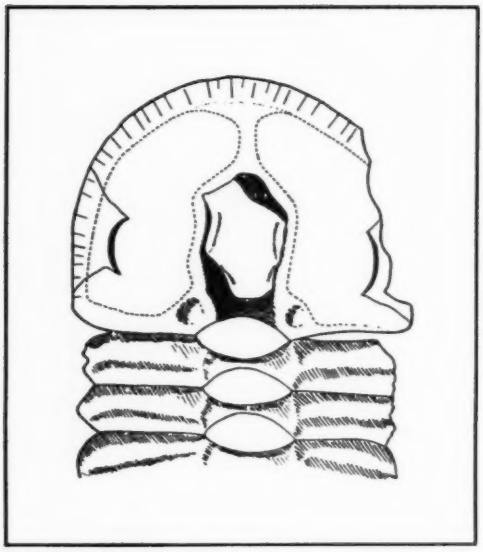

FIG. 2—*Pagetia bootes* Walcott, approximately ×7. Explanatory sketch of lower left specimen in figure 1. The subglabellar (oesophagal) cavity (black) is covered by the hypostoma. The lateral furrows of the hypostoma and the maculae are indicated.

Rasetti (1948) has favored separate orders, Agnostida and Eodiscida, because, in contrast with conventional trilobites, the agnostids are characterized by the constancy of their pygidial and thoracic segmentation. Some trilobite families, however, have a constant number of thoracic segments (e.g. Asaphidae) and hence by comparison it is not unreasonable to unite the agnostids into a limited and closely related group of only generic or subfamily standing.

The differences between the agnostids and conventional trilobites are considerable, as pointed out by Rasetti (1948), but no major differences are known between the cephalic structures of *Agnostus* and *Eodiscus*. The latter, as noted above, is only a blind *Pagetia*, which is certainly a trilobite. *Eodiscus* and *Pagetia*, therefore, appear to be connecting links between agnostids and conventional trilobites, and consequently, there seems to be no valid reason for removing the agnostids from the trilobites.

Several recent and elaborate classifications of the agnostids, which propose the recognition of a multitude of genera, subfamilies, and families, are very artificial and are out of all proportion to the systematic importance of this group. These classifications, like Tullberg's subdivisions, are determinative keys, rather than biological or phyletic systems. The same may be said for Kobayashi's (1944) classification of the eodiscids.

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JOURNAL OF PALEONTOLOGY, VOL. 26, NO. 2, P. 275, MARCH 1952

NOMENCLATURAL NOTE

NEWAAGIA, NEW NAME FOR *PHILIPPIELLA* WAAGEN

LEO GEORGE HERTLEIN
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The name *Philippiella* was proposed by Lukas Waagen in April, 1907 (Abhandl. K. K. Geol. Reichsanst., Bd. 18, Heft 2, p. 173) for a genus of Pelecypoda based upon *Terquemia obliqua* Münster [=*Spondylus obliquus* Münster] (Beitr. Geogn. Petref.-Kunde, Heft 4, 1841, p. 74, pl. 6, fig. 34), a species from the Carnic Triassic of St. Cassian, southeast Tirols, Austria. The name *Philippiella* also had been proposed prior to this for a genus of Pelecypoda by von Martens & Pfeffer in 1886 (Jahrb. Wiss. Anst. Hamburg, Bd. 3, p. 119). Cossmann in 1909 (Rev. Crit. de Paleozool., Vol. 13, No. 1, p. 67) attempted to rectify the nomenclature by proposing *Lucasiella* for Waagen's genus. That name however, had been used for a genus of Arachnida by Banks in 1900 (Canad. Ent., Vol. 32, p. 32). It appears necessary to furnish another name for *Philippiella* of Waagen, therefore *Newaagia*, derived from an anagram of Waagen, is here proposed with the type species *Spondylus obliquus* Münster.

MANUSCRIPT RECEIVED AUGUST 24, 1951

NOTICE

The Cordilleran Section of the Geological Society of America will hold its forty-eighth annual meeting on Friday and Saturday, April 11 and 12, 1952, on the campus of the University of Arizona under the sponsorship of the Arizona Geological Society.

Outstanding feature of the program will be a panel discussion on orogeny. Members of the panel and their subjects will be:

Hugo Benioff: Evidence from seismology on the nature of orogeny.

W. H. Easton: Evidence from stratigraphy on the distribution of orogenies in space and time.

H. N. Fisk: Sedimentation and orogeny, with particular reference to the Gulf Coast geosyncline.

James Gilluly: The connection between orogeny and epirogeny as deduced from the history of the Great Basin and the Colorado Plateau.

Jean Verhoogen & Frank Turner: The relations of igneous and metamorphic rocks to problems of orogeny.

The Seismological Society of America, the Mineralogical Society of America, and the Pacific Coast Branch of the Paleontological Society will also meet at this time.

There will also be an informal panel discussion of the types of geological training currently desired and the opportunities that exist for advanced students. This discussion will be by prominent representatives of professional, commercial, and governmental agencies.

Four concurrent one-day pre-meeting trips and one two-day post-meeting trip are planned. Pre-meeting trips will be held April 10, 1952, and will include a groundwater trip, a stratigraphic trip, a trip to the Santa Catalina Mountains to review the "granitization" problems, and an economic geology trip to a base metal mining district.

The two-day post-meeting trip will be held April 13 and 14. It will feature a reconnaissance to show structure, stratigraphy, igneous geology and some economic geology representative of southern Arizona.

A guide book covering these trips is being prepared.

Reservations and arrangements for displays and special luncheons should be made through the Arizona Geological Society.

JOURNAL OF PALEONTOLOGY, VOL. 26, NO. 2, P. 276, MARCH 1952

REVIEW

TERTIARY NAUTILOIDS OF WEST-COASTAL AFRICA by A. K. Miller. Annales du Musee der Congo Belge Tervuren (Belgique), Sciences Geologiques, vol. 8, June, 1951.

This timely memoir is a sequel to the author's Geological Society of America Memoir on Tertiary Nautiloids of the Americas (1947). A second report on Eocene nautiloids from British Somaliland by Haas and Miller is awaiting publication by The American Museum of Natural History. To those who plan to attend the 19th International Geological Congress this report should be of special interest.

The present memoir demonstrates again Miller's unexcelled technical skill in organization of text and illustrations. There are 89 pages of text, one table, 18 text figures and 31 plates. The text includes the usual thorough chapters on Introduction and Acknowledgements (2 pages), Previous Work (2 pages), Occurrence (7 pages), Comparisons with Related Faunas (5 pages), Cenozoic Development of Nautiloids (2 pages), and Systematic Paleontology (50 pages). There is also a French résumé, an extensive bibliography and an index.

There are 16 species in 6 genera in the faunas discussed, distributed from Morocco to South-West Africa. The majority of specimens came from the Paleocene-Eocene sea cliff at Landana, Cabinda, but the most varied material came from French West Africa, especially Senegal. No previous extensive treatment has been given to these early Tertiary nautiloid faunas. Miller again concludes that Tertiary nautiloids are not good index fossils. He, however, does point out the similarity of some of his African nautiloid faunas with those of the Texas Midway and that both of these are probably older than the nautiloid-bearing beds of the Danian.

The chapter on Cenozoic Development of Nautiloids is essentially a revised summary of similar chapters in two earlier publications. The major innovations are the author's recognition of Mesozoic species of *Cimomia* and *Hercoglossa*. In earlier reports the author has favored the derivation of *Nautilus* from *Eutrephoceras*. In the present report he expresses uncertainty over this relationship. He still maintains *Nautilus* as coming from either *Eutrephoceras* or *Cimomia* but at the same time is unable to recognize any intermediate forms.

The chapter on Systematic Paleontology contains descriptions of one new species of *Eutrephoceras*, two of *Cimomia*, four of *Deltoidonautilus*, and one of *Aturoidea*. The most important taxonomic innovation is the creation of a family Eutrephoceratidae for the one genus *Eutrephoceras*.

The report would have been more easily read if a locality map had been included. The publishers are to be commended for a splendid printing job and the fine reproduction of the plates.

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MANUSCRIPT RECEIVED OCTOBER 20, 1951

ERRATA

In the article "The Ostracode *Cytherelloidea* in North America," appearing in the Journal of Paleontology, Vol. 25, no. 6, November, 1951, the descriptions of two new species were inadvertently reversed.

These are *Cytherelloidea ozanana* and *C. tollettensis*, page 812. The description listed under *C. ozanana* describes *C. tollettensis*, while that under *C. tollettensis* belongs to *C. ozanana*. To rectify this error the specific names and figure numbers of the published version should be interchanged. The names which appear in the explanation of Plate 117 (page 816) correctly identify the figures.

JOURNAL OF PALEONTOLOGY, VOL. 26, NO. 2, PP. 277–296, MARCH 1952

SOCIETY RECORDS AND ACTIVITIES

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‖Correspondents	5
†Honorary Members	1
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